

5-2012

Integrating Brownfield Redevelopments into the Urban Fabric

Ryan Medlen

Clemson University, rmedlen@clemson.edu

Follow this and additional works at: https://tigerprints.clemson.edu/all_theses



Part of the [Urban Studies and Planning Commons](#)

Recommended Citation

Medlen, Ryan, "Integrating Brownfield Redevelopments into the Urban Fabric" (2012). *All Theses*. 1403.
https://tigerprints.clemson.edu/all_theses/1403

This Thesis is brought to you for free and open access by the Theses at TigerPrints. It has been accepted for inclusion in All Theses by an authorized administrator of TigerPrints. For more information, please contact kokeefe@clemson.edu.

INTEGRATING BROWNFIELD REDEVELOPMENTS
INTO THE URBAN FABRIC

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of City and Regional Planning

By
Ryan Rex Medlen
May 2012

Accepted by
Dr. Mickey Lauria, Committee Chair
Dr. J. Terrence Farris
Prof. Stephen Sperry

Abstract

The American landscape is dotted with hundreds of thousands of sites that are contaminated and underutilized. These sites bring down surrounding property values and face unique barriers that inhibit their redevelopment. Addressing these sites is complicated as a result of the number needing attention and the limited amount of resources available with which to address them. Much work has been done about the characteristics of these sites but minimal work has been done with regards to how they relate to surrounding area. The work that has been done in regards to brownfields and their relationship to the neighborhood has focused on site opportunities and how they fit with other community goals rather than neighborhood characteristics.

Through a case study approach of two North Carolina counties this paper explores how brownfields fit with the surrounding neighborhood social and economic characteristics. The findings suggest that trends exist around brownfield sites that redevelop and the type of end uses that emerge. These findings are then used to discuss developing community redevelopment strategies, how cities and communities can foster redevelopment, and recommendations for potential redevelopment funding mechanisms. These findings are also framed around indicators that are readily available from the U.S. Census Bureau for a replicable methodology.

Acknowledgements

I would like to thank my thesis committee members, Dr. Mickey Lauria, Dr. J. Terrence Farris, and Prof. Stephen Sperry for their guidance, support, and pulling me back in when I needed it throughout the thesis process and the past two years.

Table of Contents

| | |
|--|-------------|
| ABSTRACT | II |
| ACKNOWLEDGEMENTS | III |
| LIST OF TABLES..... | VI |
| LIST OF FIGURES..... | VIII |
| CHAPTER 1: INTRODUCTION | 1 |
| CHAPTER 2: THEORY & PRACTICE OF BROWNFIELD REDEVELOPMENT..... | 4 |
| 2.1: INFILL DEVELOPMENT | 4 |
| 2.2: BROWNFIELD BARRIERS | 5 |
| 2.3: ISSUES OF SOCIAL EQUITY | 8 |
| 2.4: BROWNFIELD INDICATORS..... | 9 |
| 2.5: AREA INDICATORS | 15 |
| 2.6: COMMUNITY-BASED STRATEGIES: THEORY AND PRACTICE | 19 |
| 2.7: TYPES OF BROWNFIELD REDEVELOPMENT | 22 |
| CHAPTER 3: METHODOLOGY..... | 24 |
| 3.1: RESEARCH PROBLEM & QUESTIONS | 24 |
| 3.2: PURPOSE OF STUDY | 25 |
| 3.3: STUDY AREA..... | 25 |
| 3.4: METHODS OF ANALYSIS AND VARIABLES | 27 |
| CHAPTER 4: ANALYSIS | 29 |
| 4.1: MECKLENBURG COUNTY..... | 33 |
| 4.2: WAKE COUNTY | 44 |
| 4.3: COMPARISON OF COUNTY TRENDS | 54 |
| 4.4: TAPESTRY | 56 |
| 4.5: CHARLOTTE LIGHT RAIL AND HERITAGE STREET CAR INFLUENCE | 64 |
| 4.6: SITE VISITS..... | 67 |
| 4.6.1: <i>Camden Square</i> | 67 |
| 4.6.2: <i>East Park</i> | 71 |
| 4.6.3: <i>Summit Avenue</i> | 74 |
| 4.6.4: <i>Westinghouse Boulevard</i> | 77 |
| 4.6.5: <i>Other Areas</i> | 80 |
| 4.6.6: <i>Wake County Tapestry Sample</i> | 82 |
| CHAPTER 5: FINDINGS | 87 |
| CHAPTER 6: IMPLICATIONS | 95 |
| 6.1: INTEGRATION WITH AMERICAN PLANNING ASSOCIATION MANUAL | 95 |
| 6.2: KEYS TO SITE SUCCESS..... | 100 |

| | |
|---|------------|
| 6.3: IMPLICATIONS FOR LOCAL GOVERNMENT | 102 |
| 6.3.1: <i>Appropriate Funding Mechanisms</i> | 107 |
| 6.3.2: <i>Comprehensive Planning and Zoning</i> | 111 |
| 6.4: ADDITIONAL RESEARCH | 113 |
| 6.5: CONCLUSION | 114 |
| APPENDIX | 117 |
| REFERENCES..... | 118 |

LIST OF TABLES

| | |
|---|----|
| TABLE 1: COMPARISON OF MECKLENBURG AND WAKE COUNTIES IN NORTH CAROLINA. ----- | 27 |
| TABLE 2: NUMBER OF BROWNFIELD REDEVELOPMENT AGREEMENTS. ----- | 30 |
| TABLE 3: CORRELATION VALUES OF MAPPED VARIABLES. ----- | 32 |
| TABLE 4: AREA CHARACTERISTICS FOUND IN A HALF-MILE BUFFER OF BROWNFIELD REDEVELOPMENTS IN MECKLENBURG, NC. ----- | 34 |
| TABLE 5: COMPARISON OF INDUSTRIAL AND NON-INDUSTRIAL REDEVELOPMENTS IN MECKLENBURG COUNTY. ----- | 35 |
| TABLE 6: AREA CHARACTERISTICS FOUND IN A HALF-MILE BUFFER OF IHW SITES IN MECKLENBURG COUNTY, NC. ----- | 36 |
| TABLE 7: AREA CHARACTERISTICS OF BROWNFIELD REDEVELOPMENTS IN WAKE COUNTY, NC. ----- | 45 |
| TABLE 8: INDUSTRIAL AND NON-INDUSTRIAL PROPERTY COMPARISONS IN WAKE COUNTY, NC. ----- | 46 |
| TABLE 9: AREA CHARACTERISTICS FOUND IN A HALF-MILE BUFFER OF INACTIVE HAZARDOUS WASTE SITES IN WAKE COUNTY, NC. ----- | 47 |
| TABLE 10: AREA CHARACTERISTICS OF INACTIVE HAZARDOUS WASTE SITES MORE THAN A HALF-MILE FROM A BROWNFIELD REDEVELOPMENT. ----- | 55 |
| TABLE 11: AREA CHARACTERISTICS OF INACTIVE HAZARDOUS WASTE SITES MORE THAN A HALF-MILE FROM A BROWNFIELD REDEVELOPMENT. ----- | 55 |
| TABLE 12: KEY ESRI TAPESTRY SEGMENT GROUPS. ----- | 56 |
| TABLE 13: AREA CHARACTERISTICS OF AND NUMBER OF REDEVELOPMENTS BY TAPESTRY SEGMENT GROUP. ----- | 58 |
| TABLE 14: SUBGROUPS FOR METROPOLIS AND SOLO ACTS SEGMENT AREAS. ----- | 59 |
| TABLE 15: SUBGROUPS FOR FAMILY PORTRAIT SEGMENT GROUP. ----- | 61 |
| TABLE 16: NUMBER OF BROWNFIELD REDEVELOPMENTS WITHIN A SPECIFIED DISTANCE OF CHARLOTTE LIGHT RAIL AND STREET CAR STATIONS. ----- | 66 |
| TABLE 17: AVERAGE AREA CHARACTERISTICS OF CAMDEN SQUARE. ----- | 69 |
| TABLE 18: AVERAGE AREA CHARACTERISTICS OF CAMDEN SQUARE AND SURROUNDING REDEVELOPMENTS. ----- | 69 |
| TABLE 19: TAPESTRY SEGMENTS REPRESENTED WITHIN A HALF-MILE OF CAMDEN SQUARE. ----- | 71 |
| TABLE 20: AVERAGE AREA CHARACTERISTICS OF THE EAST PARK BROWNFIELD REDEVELOPMENTS. ----- | 73 |
| TABLE 21: TAPESTRY SEGMENTS REPRESENTED A HALF-MILE FROM THE CENTER OF THE EAST PARK AREA. ----- | 74 |
| TABLE 22: AVERAGE AREA CHARACTERISTICS OF THE REDEVELOPMENTS ON SUMMIT AVENUE. ----- | 75 |
| TABLE 23: TAPESTRY SEGMENTS REPRESENTED A HALF-MILE FROM THE INTERSECTION OF WEST MOREHEAD AND SUMMIT AVENUE. ----- | 76 |
| TABLE 24: AVERAGE AREA CHARACTERISTICS OF THE REDEVELOPED INDUSTRIAL SITES OFF WESTINGHOUSE BOULEVARD. ----- | 78 |
| TABLE 25: TAPESTRY SEGMENT REPRESENTED A HALF-MILE FROM WESTINGHOUSE. ----- | 78 |
| TABLE 26: AREA CHARACTERISTICS A HALF-MILE FROM HUTCHINSON SHOPPING CENTER. ----- | 81 |
| TABLE 27: AVERAGE AREA CHARACTERISTICS OF INACTIVE HAZARDOUS WASTE SITES NEAR FREEDOM DRIVE AND I-85. ----- | 81 |
| TABLE 28: TAPESTRY SEGMENTS REPRESENTED A HALF-MILE FROM THE HUTCHINSON SHOPPING CENTER. ----- | 82 |
| TABLE 29: PILOT MILLS ----- | 83 |
| TABLE 30: COSTCO ----- | 83 |
| TABLE 31: TRIANGLE DRIVE ----- | 84 |
| TABLE 32: CAL-TONE PAINTS ----- | 84 |

| | |
|--|-----|
| TABLE 33: ANCHOR MILL----- | 84 |
| TABLE 34: AREA CHARACTERISTICS OF REDEVELOPMENTS SORTED BY A GROUPING OF AREA STANDARD DEVIATIONS OF DETACHED-SINGLE-FAMILY OWNER-OCCUPANCY RATES.----- | 88 |
| TABLE 35: COMPARISON OF INDUSTRIAL SITES BASED ON BEING INSIDE OR OUTSIDE THE INNER BELTWAY OF CHARLOTTE, NC. ----- | 91 |
| TABLE 36: NEIGHBORHOOD TYPES AND CORRESPONDING BARRIERS TO REDEVELOPMENT THAT ARE OF GREATEST POTENTIAL.----- | 97 |
| TABLE 37: KEYS TO SUCCESS BY NEIGHBORHOOD TYPE. ----- | 100 |
| TABLE 38: CHARACTERISTICS OF BROWNFIELD REDEVELOPMENTS IN MECKLENBURG COUNTY, NC BY LOCATION IN RELATION TO THE BUSINESS CORRIDOR REVITALIZATION AREA.----- | 103 |
| TABLE 39: BROWNFIELD CHARACTERISTICS IN THE BUSINESS CORRIDOR REVITALIZATION AREA OF MECKLENBURG COUNTY, NC BY USE. ----- | 104 |
| TABLE 40: INDICATORS AS TO FUNDING TYPE WHICH SHOULD BE CONSIDERED. ----- | 110 |
| TABLE 41: USE RECOMMENDATIONS BY THE RELATIONSHIP OF NEIGHBORHOOD MOBILITY AND INCOME TO PROPERTY VALUE RELATIONSHIP. ----- | 112 |
| TABLE 42: OVERVIEW OF ALL 12 ESRI TAPESTRY SEGMENT GROUPS.----- | 117 |

LIST OF FIGURES

| | |
|---|-----|
| FIGURE 1: MAP OF LOCATION OF BROWNFIELD REDEVELOPMENTS IN MECKLENBURG COUNTY, NC..... | 37 |
| FIGURE 2: MAP OF DELINQUENT TAX AND INACTIVE HAZARDOUS WASTE SITES IN MECKLENBURG COUNTY..... | 38 |
| FIGURE 3: MAP OF MEDIAN HOUSEHOLD INCOME IN MECKLENBURG COUNTY BY 2010 CENSUS TRACT..... | 39 |
| FIGURE 4: MAP OF MEDIAN HOME VALUE IN MECKLENBURG COUNTY BY 2010 CENSUS TRACT. | 40 |
| FIGURE 5: MAP OF DETACHED-SINGLE-FAMILY OWNER-OCCUPANCY RATES IN MECKLENBURG COUNTY BY 2010 CENSUS TRACT. | 41 |
| FIGURE 6: MAP OF PERCENT OF RESIDENTS WHO HAVE MOVED WITHIN THE PAST YEAR IN MECKLENBURG COUNTY BY 2010 CENSUS TRACT. | 42 |
| FIGURE 7: MAP OF BROWNFIELD REDEVELOPMENTS IN MECKLENBURG COUNTY WITH A HALF-MILE BUFFER..... | 43 |
| FIGURE 8: MAP OF BROWNFIELD REDEVELOPMENTS AND INACTIVE HAZARDOUS WASTE SITES IN MECKLENBURG COUNTY. | 48 |
| FIGURE 9: MAP OF MEDIAN HOUSEHOLD INCOME IN WAKE COUNTY BY 2010 CENSUS TRACT. | 49 |
| FIGURE 10: MAP OF MEDIAN HOME VALUE IN WAKE COUNTY BY 2010 CENSUS TRACT. | 50 |
| FIGURE 11: MAP OF DETACHED-SINGLE-FAMILY OWNER-OCCUPANCY RATES IN WAKE COUNTY BY 2010 CENSUS TRACT. | 51 |
| FIGURE 12: MAP OF PERCENT OF RESIDENTS WHO HAVE MOVED IN THE PAST YEAR IN WAKE COUNTY BY 2010 CENSUS TRACT. | 52 |
| FIGURE 13: MAP OF BROWNFIELD REDEVELOPMENTS WITH A HALF-MILE BUFFER IN WAKE COUNTY..... | 53 |
| FIGURE 14: MAP OF TAPESTRY SEGMENTATION IN MECKLENBURG COUNTY..... | 62 |
| FIGURE 15: MAP OF TAPESTRY SEGMENTATION IN WAKE COUNTY..... | 63 |
| FIGURE 16: MAP OF BROWNFIELD REDEVELOPMENTS IN MECKLENBURG COUNTY IN RELATION TO LRT STATIONS. | 64 |
| FIGURE 17: MAP OF CAMDEN SQUARE AREA..... | 70 |
| FIGURE 18: ROW OF ABANDONED BUILDINGS ON SOUTH TRYON APPROXIMATELY A QUARTER-MILE FROM CAMDEN SQUARE (LEFT). AN UNDEVELOPED BROWNFIELD SITE ONE (1) BLOCK AWAY FROM CAMDEN SQUARE (RIGHT). | 70 |
| FIGURE 19: MAP OF EAST PARK AREA. | 72 |
| FIGURE 20: RESTAURANT THAT IS A REDEVELOPED BROWNFIELD ON ELIZABETH AVENUE (LEFT). REDEVELOPED BROWNFIELD ADJACENT TO NON-REDEVELOPED BROWNFIELD ON 4TH STREET (RIGHT). | 74 |
| FIGURE 21: CLUB 935 BROWNFIELD REDEVELOPMENT ON SUMMIT AVENUE (LEFT). STREETSCAPING ALONG WEST MOREHEAD STREET (RIGHT)..... | 76 |
| FIGURE 22: MAP OF SUMMIT AVENUE AREA. | 77 |
| FIGURE 23: WESTINGHOUSE BOULEVARD (LEFT). REDEVELOPED INDUSTRIAL SITE ON WESTINGHOUSE BOULEVARD (RIGHT)..... | 79 |
| FIGURE 24: MAP OF WESTINGHOUSE BOULEVARD AREA..... | 79 |
| FIGURE 25: MAP OF SELECT WAKE COUNTY REDEVELOPMENTS..... | 86 |
| FIGURE 26: APA COMMUNITY REDEVELOPMENT PROCESS FOR BROWNFIELDS. | 95 |
| FIGURE 27: MAP OF BROWNFIELD REDEVELOPMENTS IN RELATION TO THE BUSINESS CORRIDOR REVITALIZATION AREA. | 106 |

CHAPTER 1: INTRODUCTION

“Brownfields are a human-made problem borne largely out of our successes,” (Haslam, 2009: 153). They are a product of the economic evolution of the United States (US), a remnant of the rise of the industrial age, and a signifier of its decline. “Brownfields are an unfortunate, but natural consequence of maturing industrialized urban economies,” (Kaufman and Cloutier, 2006). The Environmental Protection Agency (EPA) defines them as “real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant,” (2011). Perhaps as a signifier of the eventual next step of practice, the definition of brownfields was expanded in Michigan to include “functionally obsolete” buildings regardless of whether there are environmental contaminants (Bromley-Trujillo and Hula, 2010: 277). By either definition, brownfields are a part of the built environment which may necessitate public intervention as a result of added costs making redevelopment and remediation of contamination infeasible or improbable.

During the industrial revolution and for much of the 20th century the layout of many cities could be explained through a concentric-circle model of development. Commercial areas developed at the city center, tightly-packed for low communication and transportation costs. Industrial areas and low-income housing surrounded the commercial zone. Land costs were lower than in the central business district (CBD) as the supply of land was greater and transportation costs were still lower than they would’ve been on outside of cities. These areas of concentrated industrial development emerged out of a need for access to rail and ports. Residential then existed out past the industrial and agricultural beyond that (Blair, 1991). A tradeoff between transportation costs and land costs creates a bid-rent curve which shows

higher rents in the CBD and then declining rents as distance from the CBD increases. A second location theory, the multiple-nuclear theory, explains development by identifying areas of concentrated uses which emerge out of agglomeration economies, or areas which develop in close proximity to share resources and/or reduce communication costs (Hartshorn, 1992). In either development pattern, the result has been concentrated areas of polluting industries.

As transportation costs have declined due to technological improvements, industries have begun to move further away from the CBD to take advantage of lower land costs. Augmenting this is the relocation of manufacturing work abroad as a result of globalization. These developments combined with the nature of urban development patterns have resulted in concentrated areas of brownfields in what should be areas of higher rent. Such areas are in addition to smaller and more scattered brownfields which are a product of the business cycle, such as gas stations and dry cleaners. These sites can emerge unpredictably as a result of events ranging from economic downturns to owner death or bankruptcy. Site contamination can also occur in residential areas as a result of flaking lead paint and previous use of old chemicals, such as leaded gas, in the area. In either case, the continued decline of transportation costs has resulted in lower land costs that further complicate the redevelopment of properties with potentially costly environmental cleanup.

This paper looks at how these remnants of the manufacturing era in America as well as the more mundane sites, such as dry cleaners, fit in with modern neighborhood and community development trends. While history allows us to understand where the problem arose from, there still exists much debate about how these sites could be used as opportunities in future and current planning. After an overview of pertinent literature, a methodology will be presented

and then applied to Mecklenburg County and Wake County in North Carolina. The implications of the analysis for local governments and community-based organizations are then discussed.

The analysis looks at sites from the North Carolina Department of Environment and Natural Resources voluntary cleanup program. These are sites that do not qualify for the National Priorities List and thus do not qualify for Federal funding. Similarly they are not strictly former underground storage tank sites that are covered by the Underground Storage Tank Trust Fund, however, some are in this category but include additional contamination. The sites in the analysis are everyday brownfield sites. The significance in them is in the long-term detriment they can be to their community, especially if they accumulate. Ignoring these sites risks allowing communities to enter avoidable states of economic decline as will be shown through discussion of the prisoner's dilemma concept and in neighborhoods analyzed. These are sites where limited public and community resources exist to assist in their complicated redevelopment and sites where short-term inaction can result in long-term consequences.

Chapter 2: THEORY & PRACTICE OF BROWNFIELD REDEVELOPMENT

2.1: Infill Development

Areas of infill development face unique barriers compared to greenfield development. Infill has garnered attention relatively recently as the real costs of urban sprawl have become realized. Given infill development often occurs in the inner-city, many “are challenging development environments because of deteriorated infrastructure, patterns of disinvestment and abandonment,” (Farris, 2001: 7). Whether an infill development is viable may depend on whether these barriers are offset by assets unique to infill sites such as “accessibility to transit and proximity to employment centers,” (Farris, 2001: 6). With the correct location, infill and brownfield sites can be significant community assets. Meyer and Yount (2003) categorize their advantage on the basis of public and private:

“(a) from a private sector perspective, their location may offer exceptional profits from successful reclamation and reuse; and (b) from a public sector perspective, their regeneration, may contribute to both the economic and community development goals of the municipalities in which they are located.”

(233)

As attractive as such opportunities sound, the cost of capitalizing on them is often significantly higher than traditional development or they face barriers from market distortion making greenfields more appealing. Common barriers include holdouts, property owners that demand a price higher than their property is worth, and resistance to neighborhood change. These barriers

make general infill development challenging, but additional barriers unique to brownfields complicate things further.

2.2: Brownfield Barriers

Three common barriers to brownfield redevelopment, in addition to general infill development barriers, are issues of liability, cost of cleanup, and added time to the development process (Ferski and Schreiber, 1998: 12). Traditionally the argument is that “the single most significant deterrent to the reuse of brownfields is liability for cleanup,” (IEDC, 2011) as well as liability for the effects of the contamination on other sites. The issue of liability rose to the forefront of brownfield issues with the passage of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980 which, with the intention of forcing environmental cleanup, enabled any party associated with a contaminated site currently or formerly to be held liable regardless of fault. Meyer and Yount (2003: 235) argue that court interpretations complicated matters and were detrimental to the original intentions citing decisions which found lenders liable for contamination if they foreclosed on a brownfield site. Lender liability means additional limitations in financing brownfield projects, this issue coupled with CERCLA enabling transporters and third-party purchasers to be held responsible means liability is a substantial barrier, not only for financing brownfields, but also for financing their remediation, and locating potential developers. Greater barriers means increased risk, which leads to investor expectations of higher returns on sites that are already perceived as producing lower returns than greenfield projects (Farris, 2001).

In 2002 the Small Business Liability Relief and Brownfields Revitalization Act mitigated some of the unintended negative effects of CERCLA after continued decline in manufacturing

created hundreds of thousands of sites. Supplementing this legislative act is new private sector financial products. Insurance companies have “tentatively entered the brownfields arena by offering several products intended to protect project developers both from liability associated with their remediation (pollution liability policies),” (Hollander and Kirkwood and Gold, 2010: 17). Additionally, stop-gap insurance policies have emerged to limit the amount of remediation expenses, thus making the cost of cleanup more predictable reducing risk of insolvency (Ferski and Schreiber, 1998: 12; Hollander and Kirkwood and Gold, 2010: 17). Liability control is one five broad classes of public assistance in developing brownfield sites; other forms include regulatory relief, public site reclamation, constraints on new development of greenfield sites, and direct financial support (Meyer and Yount, 2003).

In terms of mitigating the liability and handling the numerous, but less heavily contaminated sites, the more significant legislative acts have occurred at the state level. While there is variation in the methodology, state programs are designed to enable the redevelopment of brownfield sites in a fiscally and environmentally responsible manner. States operate Voluntary Cleanup Programs (VCPs) which outline how the state will provide financial assistance or support, liability relief, or assistance with cleanup (Bartsch et al., 2004: 145). A survey of the various programs shows many assist with site evaluations that aid developers in making informed decisions thus providing a better perspective on what projects may be feasible. The IEDC (2011: 60-61) notes that currently 45 states have superfund laws which focus on heavily contaminated states and more than half have laws that relax liability, especially on lenders in order to free up private capital to finance the projects. Some states, such as Georgia, combine liability relief and financing. This can be done, for example, by protecting purchasers

who agree to clean up the site from liability and abating property taxes so they can recover the costs of doing so (USEPA, 2011a: 44-45).

States can also adjust remediation standards by banning residential uses or the drinking of groundwater at contaminated sites (Guignet and Alberini, 2010: 9). Lead is among several metals, but is the most common, that can be found at contaminated sites and, as a neurotoxin linked to learning and behavioral problems, lead also illustrates the health effect of brownfields (Hollander and Kirkwood and Gold, 2010, 30). Depending on past usages, brownfield contaminants can include, among others, volatile organic chemicals (gasoline), pesticides, and complex manmade chemical compounds. Such contamination can be found in the soil, water (ground or surface), and the air. These variables vary in degree by site, affecting cleanup costs and methodology. New methods of remediation are constantly emerging and can include both treatment and containment strategies. One development in an experimental stage of note is the emergence of utilizing plants as a low cost treatment option (Hollander and Kirkwood and Gold, 2010). The level of cleanup required can vary by site end use, usually leaving residential requiring the most extensive and expensive cleanups (Howland, 2010: 49).

Service is another goal of VCPs, as it is noted that staff experience can result in quicker redevelopments (BenDor and Metcalf and Paich, 2011; Bacot and O'Dell, 2006). VCPs set up a framework for the government to expedite brownfield cataloging and a way to directly allocate funds. These programs are financed predominately through Federal EPA grants, charged program fees, and state general funds as well as occasionally interest accrued through redevelopment funds. Tax programs, such as abatement, are less formulaic. This is due to variations in legislation, such as in South Carolina where tax incremental financing (TIF) can only be used on publicly owned investment and in Washington which not only requires investments

to be publicly owned but also exempts property taxes for services such as schools, limiting the amount available to invest. Bartsch et al. (2004: 128) argue “the most successful communities will leverage a variety of public and private sources for brownfield revitalization,” and that it is best done at the local level where federal, state, and city sources of funding can be agglomerated.

2.3: Issues of Social Equity

The U.S. Conference of Mayors (2010: 10) asserts there currently exists between 400,000 and 600,000 sites in the United States. The fact that so many sites exist after over two decades since garnering national attention, as well as the issue of new brownfields emerging with changes in the urban landscape, highlights why a shortage of public funds is a pertinent problem. Market-forces often guide development prioritization, leading to the direction of public funds towards sites that are already either economically viable or semi-viable for redevelopment. The rationale being that “the excess of brownfield sites relative to demand indicates that available state and local funds should be directed to making the most viable brownfields more competitive,” (Simons and Iannone, 1997: 4). But as Green Leigh notes (2000: 1) this strategy “creates the potential for widening existing inequalities between better-off and worse-off neighborhoods.” While these strategies are often successful at redeveloping downtown brownfields or sites with uniquely large acreages in developed areas, there remains an undetermined number of what Bartsch et al. (2004: 128) refer to as “upside down” brownfields, or sites “where contamination costs might exceed real estate value.” Thus without public assistance the most derelict sites will remain, commonly in areas of already depreciated land value and condition.

McCarthy (2009: 225) conducted a survey of brownfield redevelopments with and without public assistance in the city of Milwaukee, WI and found that “proportionally, more city-assisted brownfield redevelopments should have occurred in neighborhoods containing relatively higher concentrations of brownfields and minorities and/or poor people in order for environmental justice to be evident.” Included are statistics showing a disproportionate number of brownfields still exist in minority and low income areas. Little work has been done in the area, however, and McCarthy failed to address the role level of environmental degradation and job creation potential for working class residents. Advocating strictly for brownfield redevelopment in low income areas has the implication of increasing property values which in turn could result in gentrification and economic displacement. Green Leigh (2000: 7) suggests exploring a connection between developing green-spaces out of low market potential brownfields, but later states “the affinity people have for green space can be observed in the increased real property values and marketability of property located near open space,” (33). Current literature is sufficient to argue social disparity exists in terms of brownfield redevelopments, but it fails to address the inevitable externality of displacement in the same areas.

2.4: Brownfield Indicators

The extensive studying of brownfields has produced a significant amount of indicators by which to measure the effect of brownfields on economic development, market feasibility, and environmental health concerns. These indicators are mostly subjective, but grounded in basic theory; the ones that are useful vary depending on the purpose of the study, the site, and the city. Many of the indicators are typical of market analysis and redevelopment, but to isolate just the economic aspect results in incomplete information. “To weigh the true effects of

brownfield policy for cities, research must embrace an examination that includes elements of environmental and economic policies,” (Bacot and O’Dell, 2006: 143). In addition to the purpose of study, the indicators of value vary between the actors involved. “Depending on whether one is a real estate agent, a site selection consultant, or a developer, there are separate categories of decision factors pertaining to location,” (Thomas, 2002b, 95). Generally, data indicators about brownfield can be categorized as being purposed to measure brownfield performance, prioritize sites for public investment as well as specific uses, and identify areas of economic viability for redevelopment.

What warrants a successful brownfield performance may vary between the private and public perspective, but the different measures can be complementary. “Local level public participation in financing appears to provide a needed “comfort level” for developers,” (Meyer and Yount, 2003: 242). Shared financing implies shared liability and vestment in the success of the project. Through programs such as TIF, local governments are able to provide improvements and investment which make an otherwise doomed project viable. Barring significant and direct endangerment to the public welfare, however, cities must be able to plan on recuperating losses through growth in the local economy and tax base. The IEDC (2011: 73) argues that the brownfield redevelopment should be linked with strategies of business creation, encouragement of positive trends, job creation, and capitalizing on city and neighborhood opportunities. To measure the success in terms of these strategies, two elementary indicators are measuring investment in terms of cost per job and the ratio of private to public dollars invested (IEDC, 2011: 79; Meyer and Yount, 2003: 236). More detailed literature notes that market viability of brownfields has significant dependence on the private sector needs. Bacot and O’Dell (2006: 150) identify return on investment, property value, and end use of site, which

often hinges on the level of cleanup performed or necessitated, as indicators of effective brownfield policy.

Property value is one of the more important indicators and one that unifies the public and private interests. Increased property values mean increased returns on investment and expansion of the assessed property value means increased property tax income for local governments. Such expansion is needed to pay off debt accrued through public investment. Increases in property value can occur either as a result of the added value of the site being redeveloped or by increases in the value of surrounding properties. This leads to a balancing act in public investment between redeveloping brownfields for uses which may not increase neighborhood property values but require less cleanup and therefore tend to be more affordable while still mitigating the significant environmental damage (Swickard, 2008: 132; Bacot and O'Dell, 2006: 150). For example, researchers have found that brownfields existed that were suitable to be retrofitted and produce almost six thousand (6,000) megawatts of solar and wind energy in Michigan (Stromberg, 2009: 8). Additionally, bioremediation is an emerging process using certain plants to decontaminate a site over time, while not appropriate for immediate reclamation this could be utilized as an interim use (Hollander and Kirkwood and Gold, 2010: 31-32).

In a survey of key stakeholders it was noted by 61% that brownfields impact on neighboring properties "was negative largely because of blight, fears of contamination, and the sense that the site was a sign of poor quality of life in the community," (De Sousa and Westphal and Wu, 2011: 101). The same survey found residential and parks as being rated the best end uses of brownfield redevelopments for neighboring property values. In a study of two brownfields in Kenosha, WI it was estimated that neighborhood property values would increase

an additional amount between 62% and 101% higher if the two sites were converted to green-spaces as well as being remediated (Kaufman and Cloutier, 2006: 28). But in a survey of brownfields in Milwaukee, WI, commercial end use sites are noted as producing the greatest increase of adjacent property values followed by parks, residential, and industrial in order respectively (De Sousa and Westphal and Wu, 2011: 105). Property values may be the key indicator of brownfield success, but it is itself the product of other indicators which are also inherently important to brownfields.

Location and lot size are two basic factors that should have the most impact on property value. Haslam (2009: 157) finds “locations that possess a high degree of demand for infill areas are often successful in promoting brownfield redevelopment. This demand can decrease the difference between infill and new development enough to make the infill land price competitive.” Thomas (2002b: 103) argues that different size lots affect what the possible end use of a site could be and therefore would influence the feasibility of redevelopment. Bacot and O’Dell (2006: 155) acknowledge larger lots better allow for developers to increase their return on investment but note that this was not supported by redevelopments in Charlotte, NC. They conclude “that site size is somewhat mitigated by the viability of the market demand for property in or near the proposed redevelopment area.” This in addition to Haslam’s argument which suggests that larger lots may result in lower cleanup cost per acre as certain fixed costs exist in brownfield redevelopment, but market demand is the more significant influence on a greater number of projects. The latter point is supported by differences within the literature as to what end use is found preferable in case studies, stakeholder interviews, and legal requirements (Thomas, 2002b; Swickard, 2008; Guignet, 2010; De Sousa and Westphal and Wu, 2011; Howland, 2010).

Market demand as an indicator of brownfield redevelopment proves problematic as it is often compromised of a seemingly endless array of site-specific variables which make it hard to identify sites that are economically viable, viable under the right conditions (use, coordinated actions with surrounding area, etc.), and those that are viable only for abandonment. The IEDC (2011) suggests elements to promote include access to various transportation modes, a healthy consumer base, and access to a labor and suppliers. Howland (2010: 50) through a series of site visits and stakeholder interviews identified a host of site-specific barriers including out of date infrastructure, odd site shapes, and incompatible existing land uses. She also makes the observation that “contaminated parcels being converted to residential use require more stringent and expensive cleanup than parcels remaining in industry, pressing property values lower, thereby requiring government intervention and subsidy,” (Howland, 2010: 49). A similar argument is made by Swickard (2008: 132), “the expenditure of funds to clean up a site beyond what is necessary to protect health and welfare is an inefficient and wasteful use of scarce private investment resources that could be better spent initiating source control on spreading contaminant plumes at other sites.”

Thomas (2002a: 19-20) argues the most time consuming but also the most critical aspect of land use decisions surrounding brownfield is that of user needs analysis, requiring both active analysis of the specific users and passive analysis of theory and case studies. Rather than cities establishing a comprehensive city catalog of brownfield sites, “it may make more sense to determine user requirements early in the process and to design a phased system to meet these requirements,” (Thomas, 2002a: 20). However, focusing too much on user needs can result in the devotion of significant time and capital inadvertently obligating the city or a

developer to a specific site even though it may not be the site that will produce the best return on investment (Chrysochoou et al., 2011: 71).

Contrary to the above, research has emerged which emphasizes a broader, community focus on brownfield site selection. Rather than studying brownfields on a site-specific basis with the end use in mind, in theory this would result in study of areas and determine how to develop brownfields based on neighborhood characteristics. "By studying the localized context of individual brownfields within a broad dynamic framework, municipalities enhance their capacity to respond to heterogeneous circumstances hindering redevelopment activity," (BenDor and Metcalf and Paich, 2011: 932). A location based classification system, as opposed to a project or site-specific one, can be utilized to "provide a tool for organizing and visualizing information that can serve as a valuable input into the decision-making process," (Chrysochoou et al., 2011: 72). This technique focuses on identifying areas to target brownfield redevelopment through allocation of limited public funds.

Looking at brownfields from an area perspective introduces new variables which can be seen as influential. One used in both location-based analysis and a site-specific analysis is the local unemployment rate. Walzer, Hamm, and Sutton (2006: 85) used unemployment rate in an analysis of successful brownfield redevelopments, arguing "unemployment could be attractive to business investors requiring a labor force with relatively low wages." Using similar logic from a different perspective, Chrysochoou et al. (2011: 74) include unemployment in their analysis because brownfield "development is often connected with job creation and it is desirable to create new jobs close to the locations with maximum need." Thomas (2002a) looked at site selection methods but included the areal characteristics of unemployment and labor, identifying characteristics of the workforce within 30 minutes of a brownfield site as a top social variable.

Studying the economic activity shed is important to the whole picture, but the area of effect brownfields have on most issues is much smaller. In a study of Milwaukee and Minneapolis, 2000ft is a maximum distance where the effect was found statistically significant for both (De Sousa and Wu and Westphal, 2009: 103-105).

An area strategy can reduce time in terms of waiting on site selection as well as allow for flexibility on the part of the public sector to better integrate brownfield redevelopment with other community development strategies. If such a strategy can identify areas with high concentrations of developable brownfields, use that area to initiate a higher number of brownfield projects using the same funds then it can trigger a positive feedback loop to increase funding for redevelopment projects in general (BenDor and Metcalf and Paich, 2011: 916). Chrysochoou, et al. (2011: 88) propose a scenario to this effect in Hartford, CT which suggests targeting sites of the highest environmental contamination in brownfield dense areas to trigger a domino effect eventually eliminating brownfields in the neighborhood. Conducting a broad survey of available sites and their areal suitability can help identify sites where remediation may produce higher rates of return even if the individual site does not initially appear to be the most desirable project.

2.5: Area Indicators

Brownfield sites are often selected based on their location. Location affects the rent or returns on investment a developer can expect to receive and it affects how interested or disinterested a public or non-profit entity may be in assisting a project. In a survey of public and private stakeholders, De Sousa (2005: 323) found the greatest weight in terms of performance evaluators was given to increasing the local tax base. Interestingly, in this same study the public

officials rated the effect on property values to be second most important, but the private stakeholders viewed reducing contamination risks as second. Regardless of weight, all three evaluators focus on the area surrounding the brownfield and less about the site specifically. Evaluators that were labeled important, but less so, included a mix of other area indicators and site-specific indicators, such as a ratio of private to public dollars leveraged. It is useful then to understand what indicators can be used to frame the condition of neighborhood and areas surrounding brownfields.

Part of what created the problem of brownfields, in addition to economic shifts in terms of manufacturing and the lowering of transportation costs, is an evolution of the physical structure of the metropolitan area. In the early to mid-20th century, development of cities shifted from a monocentric structure to a polycentric structure, leading to the emersion of realms or “semi-autonomous subregions.” The character and number of realms varies based on the size of the metropolitan area, physical barriers which may exist, economic activity, and the transportation system (Lang and Knox, 2009: 791-792). The latter two characteristics have led to the successful pairing of transportation projects and brownfield redevelopments. Amekudzi and Fomunung (2004) conducted a survey of city projects that featured both transportation and brownfield projects, finding freight to be the most popular transportation element included but also the presence of mass transit and pedestrian-oriented development. Based on their findings, freight and mass transit seem to act as enablers to brownfield redevelopment; freight projects allow greater access for transporting cargo and mass transit brings in people, both allowing economic development. The former is necessary in older industrial areas to update them to modern standards. The latter is beneficial to commercial and residential developments due to added amenities and increased daily population. Amekudzi and Fomunung (2004: 211) also

make the noteworthy observation that partnering brownfield and transportation projects can increase funding by adding new sources of revenue. Focusing on area can help link brownfield redevelopment to other development activities, as is seen with transportation projects.

Spatially targeting funding requires selection of an area under the right conditions. Generally there is a five-stage cycle neighborhoods go through, the longest phase of which is slow but constant decline in terms of relative property value and housing quality (Knox, 1994: 236). During the two phases of varying decline, population changes and turnover rate as well as change are identified as key indicators in addition to declining rates of investment and new construction projects. Temkin and Rohe (1996: 168) develop a model of neighborhood change that “places a great deal of emphasis on the social fabric of the community and the perceptions of the neighborhood by outside actors.” In addition to perception, their model takes into consideration social characteristics, notably “the degree of attachment felt by residents to their neighborhood,” (Temkin and Rohe, 1996: 166). Attachment ties in with the lifecycle by identifying resident physical mobility or turnover as a significant characteristic of neighborhoods. Lower mobility or lower resident turnover means residents are more vested in their community, affecting the ability of entities to acquire land and the resident’s desire for change. However, mobility alone is not an indicator of neighborhood change or condition. Schwirian (1983: 93) argues change and turnover as separate processes as “neighborhoods may change under conditions of low turnover and they may remain socially stable under conditions of high turnover.” Issues of attachment, mobility, and percent owner-occupied single-family housing influence the motivation of property owners to invest and maintain their properties. These can be connected to socioeconomic indicators such as income, age, and race to provide a basic overview of an area. If conditions are such that surrounding properties are unlikely to

renovate or prevent decline then brownfields not only exasperate this condition but also may be less feasible as return on investment will be further reduced.

Prisoner's dilemma is a game theory exercise with application to conceptualizing urban redevelopment. Property owners are adjacent to each other and the value of their land is dependent partially on the quality of the other or others. If only one property owner invests in rehabilitation, then both see increased returns. But the first owner sees less of a return as they had to expend their capital resources on the renovation, whereas their neighbor profits off proximity to the improvement and not a capital investment of their own. It is possible, if not probable, that the decreased rate of return the first owner would see could not offset the opportunity cost of performing the renovation. In most applications of the exercise, the renovation is illustrated as being a profitable investment only if both owners agree to invest. In regards to this optimality, Davis and Whinston (1961: 110) make several observations:

“Not only would such action be socially desirable, but it would seem to be individually advantageous. Note that while it might be easy for the two property owners in our simple example to communicate and coordinate their decisions, this would not appear to be the case as the number of individuals increased...The mere presence of many owners would seem to make coordination more difficult.”

In terms of brownfield redevelopment, the issue is further complicated by the fact that the site is often obsolete or there are external factors keeping the owner from investing in rehabilitation. Thus even if the site is in a neighborhood where coordinated investment is possible the brownfield still may not participate creating a disincentive for other owners to mutually invest. Such a disincentive is extremely damaging. Galster, Tatian, and Accordino (2006: 458) identify past surveys of Chicago that found “neighborhoods would only undertake

renovations if at least one third (1/3) of neighboring owners did the same.” This results in a neighborhood state of decline, exasperated by the existence of multiple brownfields.

2.6: Community-Based Strategies: Theory and Practice

The idea of focusing on or incorporating the traits of the surrounding area into public financing and redevelopment efforts is not a new concept. TIF districts are one of the primary methods of injecting funds into a community. These areas are typically mandated by state enabling laws to be areas of economic distress or blight. Additionally, the Low Income Housing Tax Credit (LIHTC) offers an added bonus to projects which occur in qualified census tracts, or tracts with an average household income of 60% the area median income. These public financing tools consider area conditions at a basic level; however additional work around brownfields has recently occurred. This includes a program in Charlotte, the Business Services Program Geography encompassing 75 neighborhoods. Sites within these neighborhoods are eligible for grant funding from the Charlotte Brownfield Program. However, similar to TIF and LIHTC, the neighborhoods are specifically characterized “by economic and neighborhood distress,” (Bacot and O’Dell, 2006: 151-152).

The American Planning Association (APA) recently produced a handbook on creating community brownfield strategies. According to the APA (2011: 97) “small brownfield properties sprinkled throughout a neighborhood or district are less marketable to developers and fail to attract enough support from local governments.” It is observed that this inaction of policy is biased towards low income and minority populous neighborhoods, as was observed by McCarthy (2009) as well. An area approach to brownfield redevelopment has acquired popularity only recently in the literature. APA (2011: 96) argues that “while there are cases

where a single brownfield redevelopment project has spurred environmental, economic, and social benefits across a neighborhood or district, it is not common for a single redevelopment to bring widespread benefits to a city or region.” Chrysochoou, et al. (2011: 72) develop “a location-specific indexing and mapping approach” that can be applied to a large area “in advance of the application of more targeted project-specific tools, in order to identify areas and/or sites that should be prioritized for funding.” The intention of both is to encourage redevelopment of brownfields based on area as opposed to specific projects in order to increase the benefit of the public investment.

In practice, the City of Portland, OR is currently developing a strategy, known as the Portland Harbor Redevelopment Initiative (Harbor ReDI), targeting a large cluster of brownfields in a traditionally industrial area. The goal is to develop a comprehensive strategy to enable the redevelopment of all the brownfield sites through coordinated investment with private developers. While similar, this program is likely to become an exception as opposed to a replicable areal brownfield strategy. Harbor ReDI is targeting large sites for industrial use, thus sites with likely lower cleanup standards and higher acreages to lower the per acre cost of remediation. There are also a relatively high number of superfund sites in the area; this implies additional funding may be available. Still, as one of the few real districting strategies insight can be gained from some of their strategy recommendations. First, Harbor ReDI conducted a study to determine the cost of developing and the opportunity cost of not developing. Second, outreach to and educate property owners on the legal issues and goal. Third, develop parcel profiles in terms of environmental standing, engineering requirements, as well as economic and demographic information. A final general strategy to note is the formulation of a standard sale agreement and protocol to expedite any sales or handling of potential buyers.

These recent developments show a progression towards areal strategies of brownfield redevelopment. This progression follows acknowledgement in the previously discussed literature showing the effect brownfields have on surrounding property values. Meyer (2003) summarizes the importance of recognizing the spatial effects of brownfields:

“If a site thought to be clean is found to be contaminated, property values nearby may fall. If pollution concerns had already depressed property values and a site was found to be clean, adjacent property values might rise. Either way, the effects of redevelopment efforts will be felt beyond any site boundaries. In addition, failures to mitigate known brownfields may also generate physical and psychological costs to nearby residents and employees at neighboring businesses.” (45)

The effects of brownfields are not limited to individual sites. Nor is their market demand determined strictly by site costs and characteristics. Brownfields and the feasibility of their redevelopment are influenced greatly by the characteristics of their neighborhood. However, as the literature has shown, brownfields can cause spillover effects which may distort perceptions of redevelopment potential. Thus analyzing redeveloped, remediated, and stagnant brownfields in relation to the surrounding neighborhood can help in identifying neighborhood issues which may prevent redevelopment. Targeting such issues or area opportunities can be justified by positive spillover effects of redevelopment and remediation replacing the current negative ones of brownfields. Richmond, VA has utilized neighborhood targeting for general revitalization and it has been found that benefits were found in adjacent blocks, “likely due to localized spillovers from the blocks receiving high investments...and a positive investment psychology,” (Galster and Tatian and Accordino, 2006: 465). Identifying these barriers can assist in developing city-wide strategies that produce a higher rate of return or better achieve a stated goal (Chrysochoou, et al., 2011).

2.7: Types of Brownfield Redevelopment

There are numerous types of brownfield redevelopments divided into several key classes. The terminology varies, thus it is important to clarify what is meant by some key terms. Particularly open space, interim use, and redevelopment. Other categories of use may be seen as existing, given that these are broad terms. However, for the purpose of this project the following descriptions should be sufficient to the reader. Additionally, a discussion of scale is also relevant as perception of brownfield redevelopment may be skewed towards larger sites.

Open space redevelopments are considered to be green spaces such as parks, segments of a greenway, permanent agriculture, or land converted back to a natural state. These uses typically require some level of remediation for public use (particularly agriculture) as contamination can occur in drinking water and be found in plants or animals that may become affiliated with the site. In contrast, interim use is land which is put to use for what is intended to be temporary purposes. This can include providing basic landscaping for a process of biological remediation, a process similar to composting, which can reduce the negative impact of a brownfield while not requiring comparable capital investment as with redevelopment. Interim uses can also include community assets such as temporary urban agriculture (APA, 2011) or a site for solar energy production (Stromberg, 2009: 8). Redevelopments are brownfield sites that have been remediated to an appropriate level and put back in to any private use or developed into a public building. These can vary in size from an acre or less to sites encompassing hundreds of acres.

A note on redevelopment is the issue of size. Highly publicized brownfield redevelopments, such as Atlantic Station in Atlanta, GA, are often large in size, developed into

mixed use. Atlantic Station itself is 138 acres. However, brownfields include small sites such as industrial condominiums and dry cleaners. The North Carolina Department of Environment and Natural Resources has entered agreements with everything from old mills to a defunct go-kart track. Defined as a site of a couple acres or less (the definition depends substantially on the density being discussed as this affects the average lot size of the area), smaller sites should be of greater relevance to community-based approaches to brownfield for three reasons. First, smaller sites can be just as significant eye-sores as larger sites and affect property values in a comparable manner. Second, smaller sites do not offer the opportunity as a high of return on investment making it more difficult for investors to cover the costs of cleanup. Lower return on investment is true for public investment as well. Finally, smaller sites are more integrated into the community, thus their redevelopment is more dependent on the condition of the surrounding area. Larger sites, such as Atlantic Station, have the capability of creating a somewhat sheltered environment and are able to minimize the impacts of the surrounding area through design. For these reasons, site-specific indicators from an investment standpoint are more likely to favor larger sites covering tens to over a hundred acres or more. Addressing smaller brownfields is important for failure to do so risks missed opportunities to improve communities held down by blight and leads to avoidable areas of decline in structural quality.

CHAPTER 3: METHODOLOGY

3.1: Research Problem & Questions

This study explores locational aspects of brownfield redevelopment, particularly in identifying key neighborhood elements. Local government agencies and communities have limited funding to address the issue of urban blight and brownfields. Spreading this funding over a broad area further dilutes its potential effectiveness in terms of facilitating community revitalization. A key aspect of brownfield redevelopment is the ability to attract private investment to augment public funding. If the desired end is redevelopment, then developers will need to see market feasibility for their investment. Neighborhood health and vitality indicators form perception and incorporate demographic characteristics important to market feasibility. By this logic, this project asks the question:

How do brownfields and their redevelopment relate to neighborhood demographics, lifecycle, and stages of decline?

By contrasting brownfield redevelopments and areas that don't facilitate redevelopment with the lifecycle and stages of decline, the goal is to understand whether a neighborhood is likely to be seen as (or close to being seen as) suitable for private investment. Incorporating the research in this way uses established theory which has added significance of being beneficial to project financing, as financiers tend to be skeptical of "alternative" indicators. In evaluating the collected data regarding neighborhoods and the redevelopment of brownfields, the data is analyzed to address the following question:

Is there a more efficient way to target areas for brownfield redevelopment funding than one that is strictly need based?

This question is used to address how the results of the research fit with practice and the community-based brownfield redevelopment process proposed by the APA.

3.2: Purpose of Study

The purpose of this study is to assist in addressing the feasibility of redevelopment for communities based on their neighborhood characteristics. Explained in terms of fitting in with the proposed development process of community-based brownfield redevelopment strategies as put forth by the APA (2011), how “Step 1: Develop a Community Vision” relates to “Step 4: Determine Reuse Options.” On a community level, the purpose is to provide indicators for a community to assess whether their brownfields are feasible to be redeveloped. Additionally, for feasible sites the research helps identify what uses may be optimal and, especially for infeasible sites, insight into ways to attract investment. For local governments, the project seeks discusses prioritizing funding for brownfields based on indicators as to the level of market feasibility and how brownfield redevelopments are currently integrated with the surrounding neighborhood. Currently a level of prioritization is already made for need-based communities through funding methods such as TIF and granting additional funds for assessment.

3.3: Study Area

This study utilizes Mecklenburg County, NC and Wake County, NC as the primary study areas. Mecklenburg County is a good study area due to the high number of existing and recently redeveloped brownfields, especially within the most populous city, Charlotte. The area has

experienced growth of over 224,000 people or 32% between 2000 and 2010, resulting in an increase in density of more than 300 people per square mile countywide. Charlotte is also the site of new transportation development projects which has resulted in substantial infill development. This activity makes Charlotte a strong candidate city for analyzing brownfield redevelopments in a locational manner utilizing multiple variables identified in the literature. Similarly, Charlotte has seen a unique number of lower acre sites redevelop (Bacot and O'Dell, 2006) which are fundamental to community redevelopment strategies. Since Charlotte has seen notable redevelopment occur, it is prioritized over so-called "shrinking cities." As the desired goal of brownfields is redevelopment, remediation, or interim utilization it is preferable to develop a methodology based on successful redevelopments as opposed to first studying cities where redevelopment is minimal. Given this project is not using a pre-defined methodology it would be potentially worrisome from a validity standpoint to contrast a shrinking city and a growing city.

Wake County is a comparable study area to Charlotte in order to improve external validity. Wake County is the second most populous county in North Carolina and experienced a comparable 43.5% increase in population and a 308 people per square mile increase in density between 2000 and 2010. Both counties feature a large, flagship city (Charlotte and Raleigh, respectively). Overall density is lower in Wake County; however, property values are higher so it is reasonable to expect demand pressure on land, including brownfields, to be comparable. Since both Wake County and Mecklenburg County are in the same state, there is consistency in both the definition of brownfields and voluntary cleanup program entrance requirements. This consistency is important so as to improve construct validity by using equivocal data sources and standards.

| | Mecklenburg County | Wake County |
|---|---------------------------|--------------------|
| Chair City | Charlotte | Raleigh |
| 2000-10 Population Growth Rate | 32.2% | 43.5% |
| 2000-10 Change in Density (people per square mile) | + 376 | + 308 |
| 2010 Population Density (people per square mile) | 1,650 | 1,041 |
| Median Home Value (05-09 ACS) | \$180,100 | \$213,200 |
| Current Number of Sites | 72 | 15 |

Table 1: Comparison of Mecklenburg and Wake Counties in North Carolina.

3.4: Methods of Analysis and Variables

The analysis explores the relationship of brownfield redevelopments with the surrounding areas from two levels of data. First it looks at the area that falls within a half-mile radius of the site. Second, some of the data requires looking at it from a census tract level utilizing 2000 boundaries. The latter unit of analysis is primarily for visual analysis of maps and for a portion of the analysis involving ESRI tapestry data which will be discussed further later on. Three different methods of analysis are used in this analysis in order to provide an overview of the study area. First, simple overlay mapping using archival data is utilized to show how the sites fit into the area based on tract-level data. Second, statistical analysis is done by aggregating area characteristics around the redevelopments found in the overlay mapping. Finally, key site visits are done to identify and check for immeasurable site characteristics as well as reinforce the trends found in the overlay mapping and statistical analysis.

The statistical analysis and overlaying mapping use key variables from the 2006-2010 American Community Survey (ACS) to identify common economic and social traits of areas with redeveloped brownfields. Neighborhood stages of decline will be mapped to show the general condition of the area. Focus here is put on percent detached-single-family that is owner-

occupied, as homeownership (or lack thereof) is a key indicator of neighborhood vitality (Ahlbrandt and Brophy, 1975). Additionally, home ownership is a general indicator of economic success and household stability, thus it provides insight into the health of the neighborhood. In support of measuring the economic quality of the neighborhood, median household income is used to reinforce whether an area is in decline based on detached-single-family housing owner-occupancy rates. Similarly, median home value is explored as well, used as a measure of general property values in the area. Land value or property value by parcel proved to be of inconsistent quality. A final variable is physical mobility or percent of people who lived in a different residence one (1) year ago. Mobility is not a definite indicator of decline, revitalization, or stabilization; rather it is an indicator of attachment (Temkin and Rohe, 1996). Greater attachment to a neighborhood may deter developers as it will be harder to garner public support for projects that may change the character of the area.

ESRI tapestry data is used to identify the general consumer characteristics and provide a unique profile of the residents of the area. Market tapestry data provides a description of the social classification of residents that will be broken down further in the analysis. More importantly, ESRI tapestry data illustrates the diversity of people in the area. This is important for identifying areas of gentrification or other shifts in social dynamisms which may be occurring concurrently with brownfield redevelopments. This data is available for census tracts and can be compiled for custom areas through the website Site To Do Business. Tapestry data along with site visits reinforce the results of the statistical analysis.

CHAPTER 4: ANALYSIS

Brownfield redevelopments were selected from the project inventory as of December 2011, for the North Carolina Brownfields Program administered by the North Carolina Department of Environment and Natural Resources (NCDENR). The sites used do not include those on the National Priorities List, or superfund sites, and do not include sites where the only contamination was underground storage tanks which receive funds from a separate trust fund. The records include a catalog of sites by a project id number and a physical site address, significant event dates, as well as a project name. Supplementary data was drawn from the Annual Report to the North Carolina General Assembly of the North Carolina Brownfields Program dated October, 2011. This report provides the site acreages, uses as agreed to in the voluntary cleanup agreement, as well as an affirmation of the date the cleanup agreement was signed. Date the property developer signed the brownfield cleanup agreement is used as the key date as this signifies a binding contract and proven intent to redevelop the site. Follow-up visits and surveys of the sites did not find anything to contradict this as an identifier of inevitable cleanup and redevelopment. ArcGIS maps and locational data collection was done using available NCDENR shapefiles of brownfield project point data and area boundaries. However, these shapefiles only included projects with agreements signed by early 2009. Projects signed thereafter were geocoded and area boundaries were selected based on county parcel data and, when possible, parcel identification numbers provided in NCDENR records. Neighborhood data collection and aggregation was done using a Euclidean-distance buffer based on area boundaries in order to consider the size of the parcels.

| County | Residential | Commercial | Mixed-Use | Industrial | Institutional | Total |
|--------------|-------------|------------|-----------|------------|---------------|-------|
| Mecklenburg | 7 | 26 | 25 | 13 | 1 | 72 |
| Wake | 0 | 9 | 4 | 2 | 0 | 15 |
| Total | 7 | 35 | 29 | 15 | 1 | 87 |

Table 2: Number of brownfield redevelopment agreements.

Total there are 87 unique cleanup agreements signed by property developers from 1998 to 2011 in Mecklenburg and Wake Counties. This is from 88 signed agreements; one was removed as it was a modified agreement for an already counted site. Given its industrial past it is not surprising Mecklenburg County is found to have the greater number of brownfield redevelopments. A breakdown of the uses is found in table 2, however, from here on uses will be discussed in terms of industrial and non-industrial. There are three reasons for this split. First, there are different cleanup standards to be met for industrial and non-industrial. Second, the site characteristics and needs are different between industrial and non-industrial uses. Third, the prescribed uses in the data and agreements are vague and occasionally the redevelopments are hard to classify. Mixed-use in particular was found to be an irrelevant term and commercial varies from an office building to restaurants to a nightclub. Industrial redevelopments are a significantly smaller proportion than other uses, accounting for 18% and 13% in Mecklenburg and Wake Counties respectively. The reason for this disparity is beyond the scope of this study as it has been noted in the literature review that there are conflicting reports as to what type of brownfield redevelopment is most common. However, it should be noted that some of the commercial uses could be classified or seen as industrial in nature, but not so many as to warp the data given the study is on brownfield redevelopments overall and not one specifically of the end-uses.

Non-redeveloped brownfields are more difficult to account for; this is due to a lack of data availability and certainty. NCDENR keeps no record of official brownfield sites, nor does Mecklenburg or Wake Counties. This issue is similar to that which any study of brownfields will face due to their broad definition. Additionally, it may not be in the best interest of local and state governments to keep detailed inventories of brownfields due to the documented impact on property values the label can have on that individual site and surrounding sites. To address this issue, two separate data layers are mapped in Mecklenburg County and one in Wake County to illustrate where brownfields are likely to occur. A visit to the areas reinforces the notion that they are at greatest risk to contain identified and unidentified brownfield sites. The first of these data layers is mapped in both Mecklenburg and Wake Counties, shows inactive hazardous waste (IHW) sites from the NCDENR database. These are sites “where a hazardous substance release has come to be located and would include active and inactive facilities and a variety of property types,” (NCDENR, 2012). They are not brownfields per se as the level of utilization is not a factor, but sites of this nature were mapped where a “no further action agreement” does not currently apply, implying possible environmental contamination until further assessment is done. These sites are found clustered around some of the redeveloped brownfield sites suggesting their ability to indicate area contamination as surrounding sites have been found to be contaminated.

In addition to inactive hazardous waste sites, Mecklenburg County delinquent tax sites from 1998 to 2010 are mapped. Parcels used were those that are consecutively delinquent from 2008 to 2010. The layer illustrates where there are sites consistently failing to meet their tax bill. Some of the sites are delinquent by a small amount, but most show a significant delinquency suggesting a level of underutilization resulting in an inability to pay bills. Improved industrial and commercial properties of this type are the final mapped layer as these are more likely to have

contamination issues. Mapped with the inactive hazardous waste sites, these two layers show the tracts with the highest propensity to have brownfields. Visits to these areas in Mecklenburg County found a significant number of abandoned industrial sites and shopping centers, as well as general economic decline. Additionally, mapping the delinquent tax sites and/or the inactive hazardous waste sites against the various economic variables shows they appear where theory suggests brownfields are likelier to be located.

The brownfield redevelopments and IHW sites is mapped against various neighborhood variables. These include median household income, median home value, percent detached-single-family homes that are owner-occupied, and percent of households that moved within the last year. Data is mapped at the tract-level then converted to raster format. A half-mile Euclidean-buffer is used to produce a mean value based on the average value of the surrounding tracts. This mean value is then converted to standard deviations based on the sites respective county average in order to show the area's position relative to the county. A correlation table of these standard deviation values for each of these sites is used to show the variables' relationship with each other.

| Variable | Mobility | Home Value | SF, %Owner-Occupied | Household Income |
|-------------------|----------|------------|---------------------|------------------|
| Mobility | 1.00 | 0.23 | -0.58 | -0.20 |
| Home Value | | 1.00 | -0.01 | 0.64 |
| SF, %Owner | | | 1.00 | 0.48 |
| HH Income | | | | 1.00 |

Table 3: Correlation values of mapped variables.

As shown in table 3, household income and home values are positively correlated, as is to be expected. Single-family owner-occupancy and mobility are negatively correlated, likely due

to the fact that renters are more mobile thus a higher rate of mobility is related to a lower rate of owner-occupancy. Acreage was also added but not found to be correlated to any variable and consequently deleted from the table.

4.1: Mecklenburg County

Figure 1 shows redeveloped brownfield sites in point form in Mecklenburg County. Many of the redevelopments fall into a radial pattern along the primary roads emanating from downtown Charlotte; some also exist in both the downtown area as well as suburbia. The largest cluster of brownfield sites is along South Boulevard just southwest of Downtown. As will be discussed later, the recent development of the Charlotte light rail (LRT) system is a significant factor in this. A second point to note is the scarcity of redeveloped brownfields directly to the south and to the southeast of downtown. This is not due to low propensity to redevelop but rather to the higher economic state of the area and the lack of brownfields needing to be redeveloped. Figure 2 shows the location of inactive hazardous waste sites and three-year-delinquent sites in terms of property tax. There are only a few IHW sites and almost an absence of delinquent tax sites suggesting contamination is less common and under-utilization is almost absent thus brownfields are not likely to be found. Conversely, there are many delinquent tax sites and IHW sites where brownfield redevelopments have been occurring. Finally, industrial sites are more likely to occur on the fringe as opposed to non-industrial redevelopments with the exception of the northern suburban areas.

Adding the census variables of median household income, median home value, mobility, and percent detached-single-family owner-occupancy rates reveals some broad trends that will be further discussed. Mapped household income (figure 3) shows redeveloped brownfields are

typically located in tracts slightly below the area median, predominately in the -0.5 to -1.5 standard deviation range. This becomes less true in the fringe redevelopments which trend toward average or above average tracts in terms of income. Looking at median home values (figure 4) shows a similar trend. However, the home values map also realizes a sharp divide between adjacent tracts. Along the southern corridors, as well as around the city center, there is a clear line of contrast between areas that are 0.5 to 1.5 standard deviations below the area median and those at or above the area median. Most illustrious is South Boulevard which shows an abrupt divide from below to more than 1.5 standard deviations above the median home value.

Abrupt transition areas can be found in a map of the percent of owner-occupied detached-single-family homes as well (figure 5). Many of the brownfield redevelopments tend to locate in tracts at least 1.5 standard deviations below the area median. Again, this trend diminishes in the suburban areas, but less so than was the case with household income. Comparing it to map 6 illustrates the correlative relationship between areas of low owner-occupancy and high rates of mobility. The map shows brownfields occurring in areas where an above average amount of people lived in a different dwelling unit one (1) year ago. However, in looking at the tracts where brownfields are located, the contrast with adjacent tracts is less visible.

| Mecklenburg | Acreage | Mobility | SF, %Owner-Occupied | Home Value | Household Income |
|-------------------------|---------|----------|---------------------|------------|------------------|
| Countywide | * | 21.80% | 85.18% | \$185,100 | \$55,294 |
| Brownfield Site Average | 10.3 | 29.70% | 66.21% | \$186,665 | \$42,348 |
| Standard Deviations | * | 0.67 | -1.20 | 0.01 | -0.45 |

Table 4: Area characteristics found in a half-mile buffer of brownfield redevelopments in Mecklenburg, NC.

Figure 7 shows the coverage area produced from a half-mile Euclidean-buffer based on the area boundaries of redeveloped brownfields. A separate mean value of the variables based on tract-level 2006-2010 ACS data is calculated for each buffer-area. There is a significant amount of overlap southwest of downtown Charlotte due to the density of redevelopments along South Boulevard in particular. Table 4 shows a breakdown of the characteristics for the 72 sites in Mecklenburg County:

The low single-family owner-occupancy rate coupled with the below average income show the general area as being in a state of minor decline and below the economic standards of the county. The home values remain average to other areas of the county, almost half a standard deviation above household income. Table 5 shows the differences between industrial and non-industrial properties:

| Mecklenburg | Acreage | Mobility | SF, %Owner-Occupied | Home Value*** | Household Income** |
|-----------------------------------|---------|----------|---------------------|---------------|--------------------|
| Industrial, Average | 13.0 | 29.43% | 68.49% | \$127,493 | \$35,668 |
| Industrial, Deviations | * | 0.65 | -1.06 | -0.45 | -0.68 |
| Non-Industrial, Average | 9.7 | 29.76% | 65.70% | \$199,703 | \$43,819 |
| Non-Industrial, Deviations | * | 0.67 | -1.24 | 0.12 | -0.40 |

Table 5: Comparison of industrial and non-industrial redevelopments in Mecklenburg County.

*** Significant at the .01 level

** Significant at the .05 level

Industrial redevelopments have a higher average owner-occupancy rate due to the more suburban location of many of the industrial redevelopments, but this not found to be statistically significant. Additionally, this breakdown suggests the difference between home

value and income is mostly with non-industrial uses as the separation between the two in terms of standard deviation becomes more exaggerated.

The IHW sites, while not necessarily brownfields, provide an indication as to where brownfields are likely to exist compared to areas where brownfield redevelopments are located. The maps show higher frequencies of these sites in areas of household income and home value in the -0.5 to -1.5 standard deviation range. In suburban areas, tracts with home values that are near the county average show more inactive hazardous waste sites compared with inner suburban or inner city tracts. A sampling of these sites with Bing Maps shows they are mostly large warehouses or factory sites physically separated from residential areas or wastewater infrastructure. In either case, in suburban areas of lower density median home values are less affected by hazardous sites. Table 6 shows the average value of the same variables based on a half-mile buffer of the inactive hazardous waste sites:

| Mecklenburg | Mobility*** | SF, %Owner-Occupied | Home Value** | Household Income |
|--|-------------|---------------------|--------------|------------------|
| County Median | 21.80% | 85.18% | \$185,100 | \$55,294 |
| IHW Average | 25.42% | 68.81% | \$164,087 | \$44,869 |
| IHW Deviations | 0.31 | -1.04 | -0.17 | -0.36 |
| Diff. in Deviations with Redevelopments | -0.36 | 0.16 | -0.18 | 0.09 |

Table 6: Area characteristics found in a half-mile buffer of IHW sites in Mecklenburg County, NC.

*** Significant at the .01 level

** Significant at the .05 level

There is an increase in owner-occupancy in these areas and a more significant decline in mobility. There are small changes in household income and home value and the two draw closer together in terms of standard deviations.

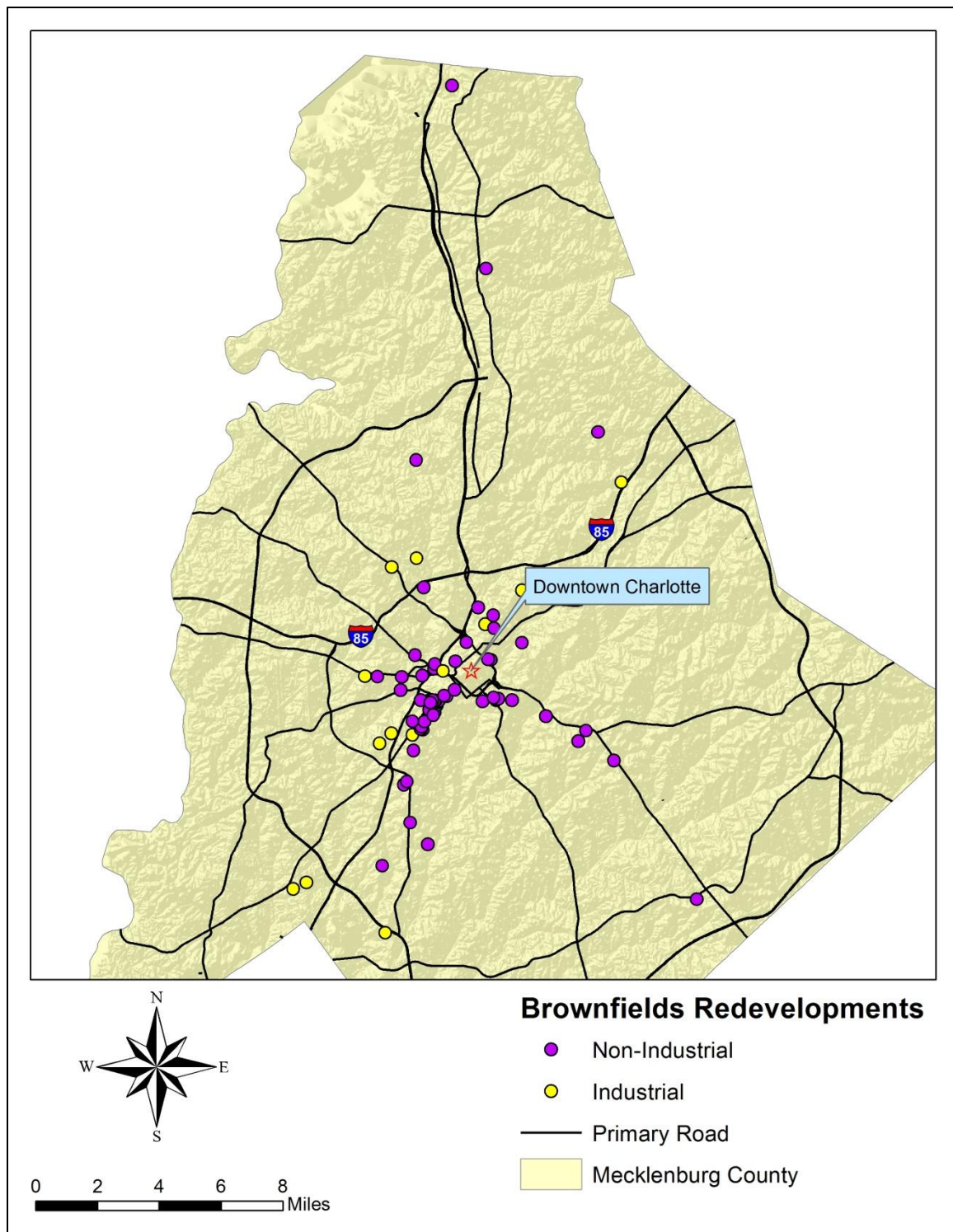


Figure 1: Map of location of brownfield redevelopments in Mecklenburg County, NC.

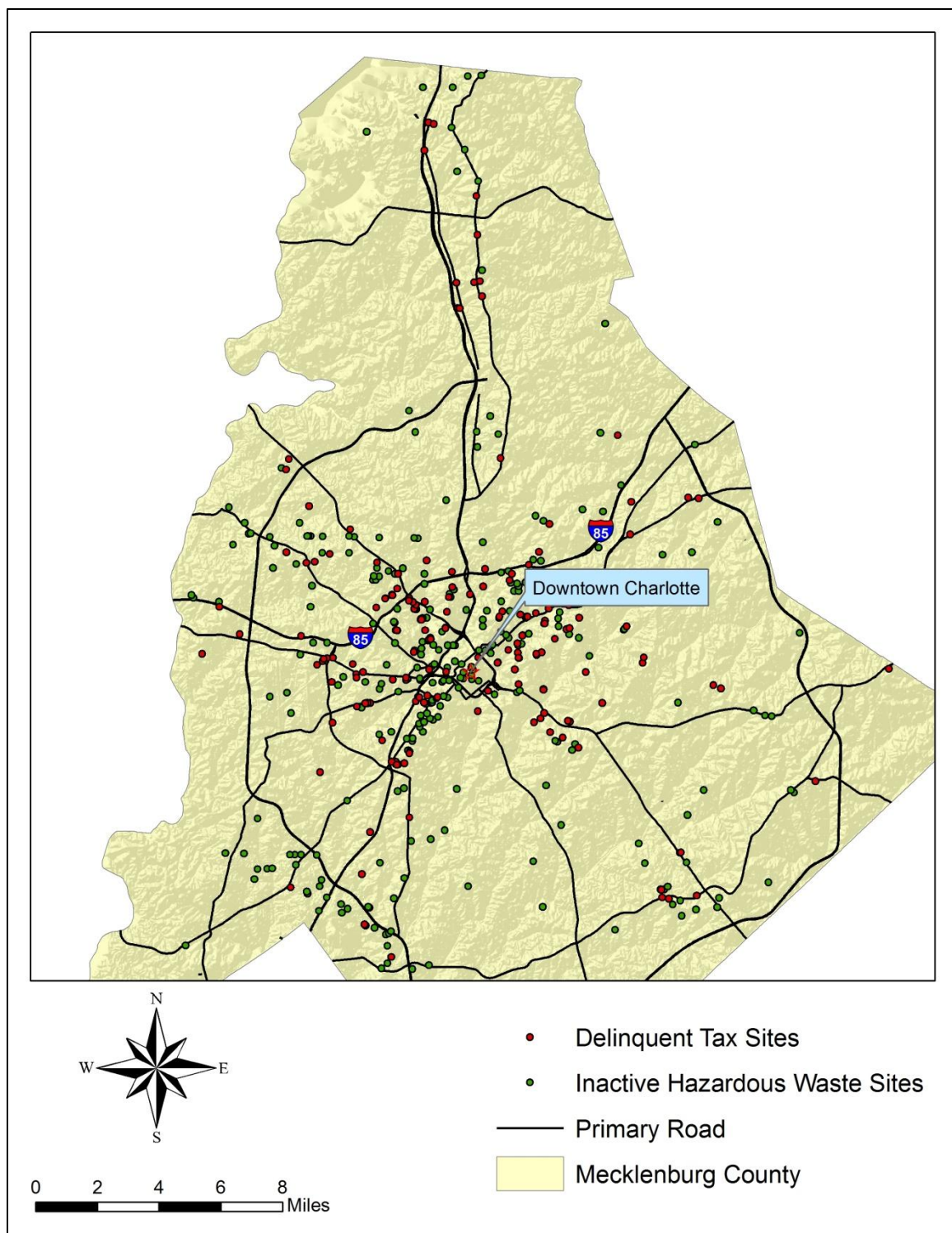


Figure 2: Map of delinquent tax and inactive hazardous waste sites in Mecklenburg County.
Source: Mecklenburg County and NCDENR

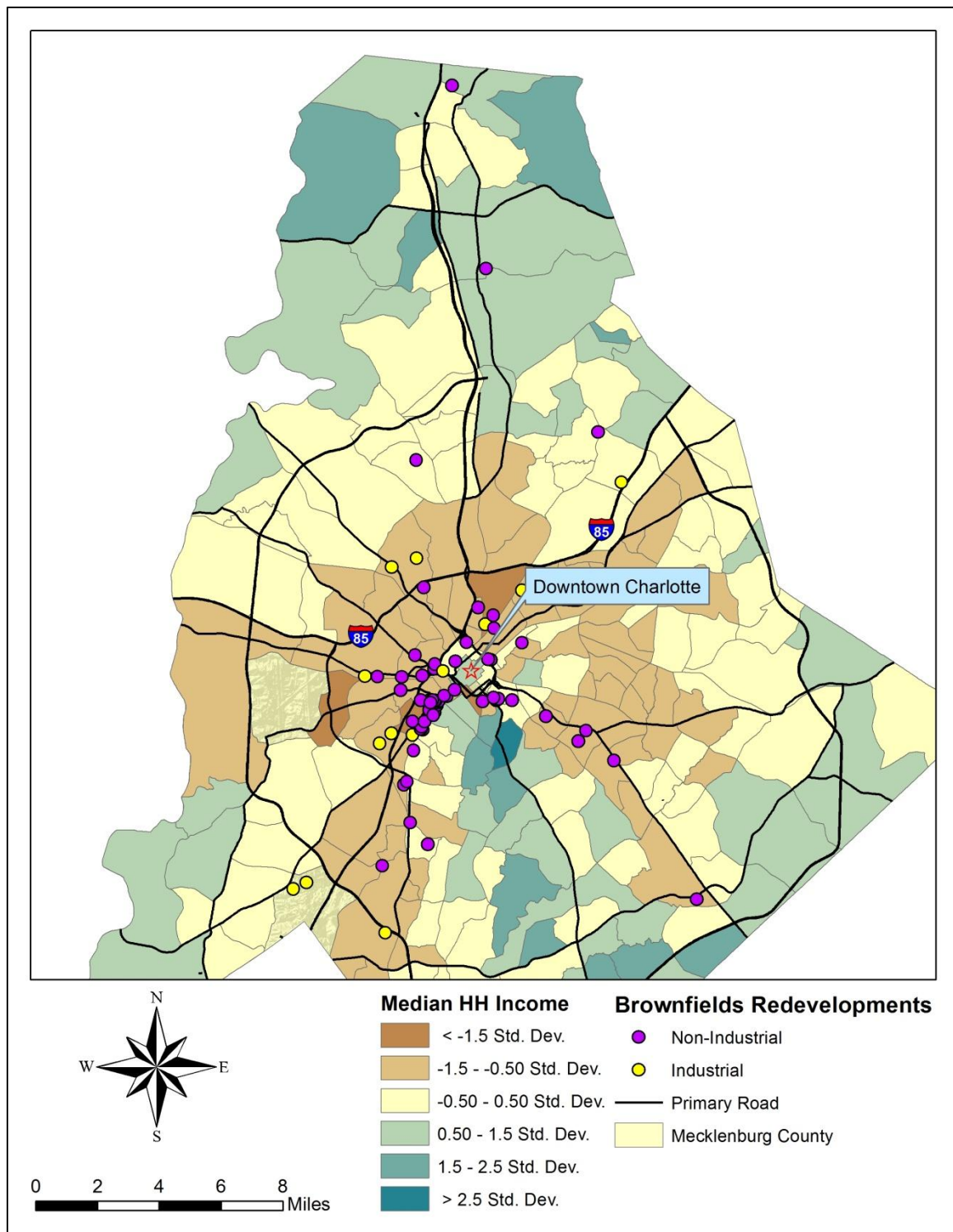


Figure 3: Map of median household income in Mecklenburg County by 2010 census tract.
Source: ACS 2006-2010

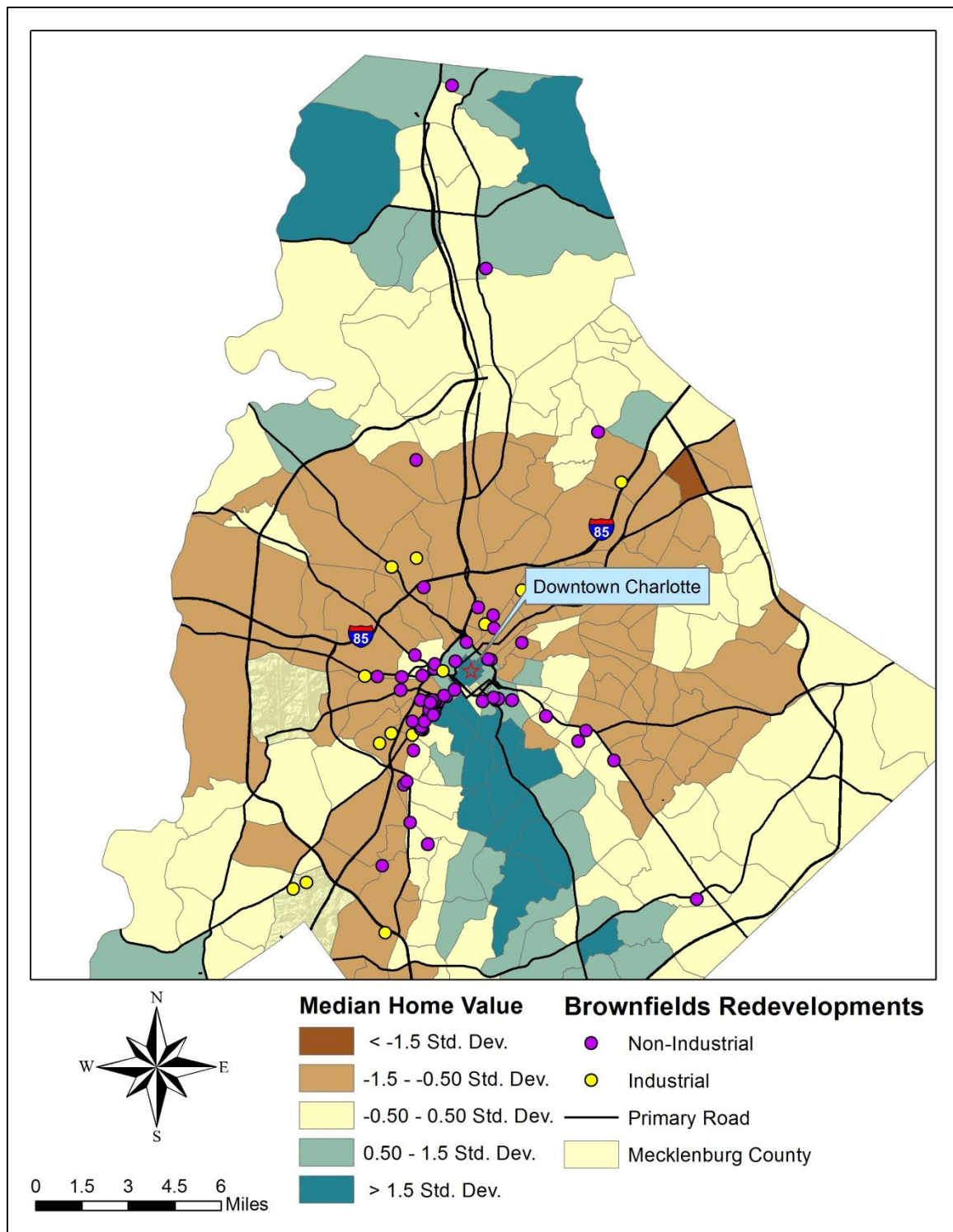


Figure 4: Map of median home value in Mecklenburg County by 2010 census tract.
Source: ACS 2006-2010

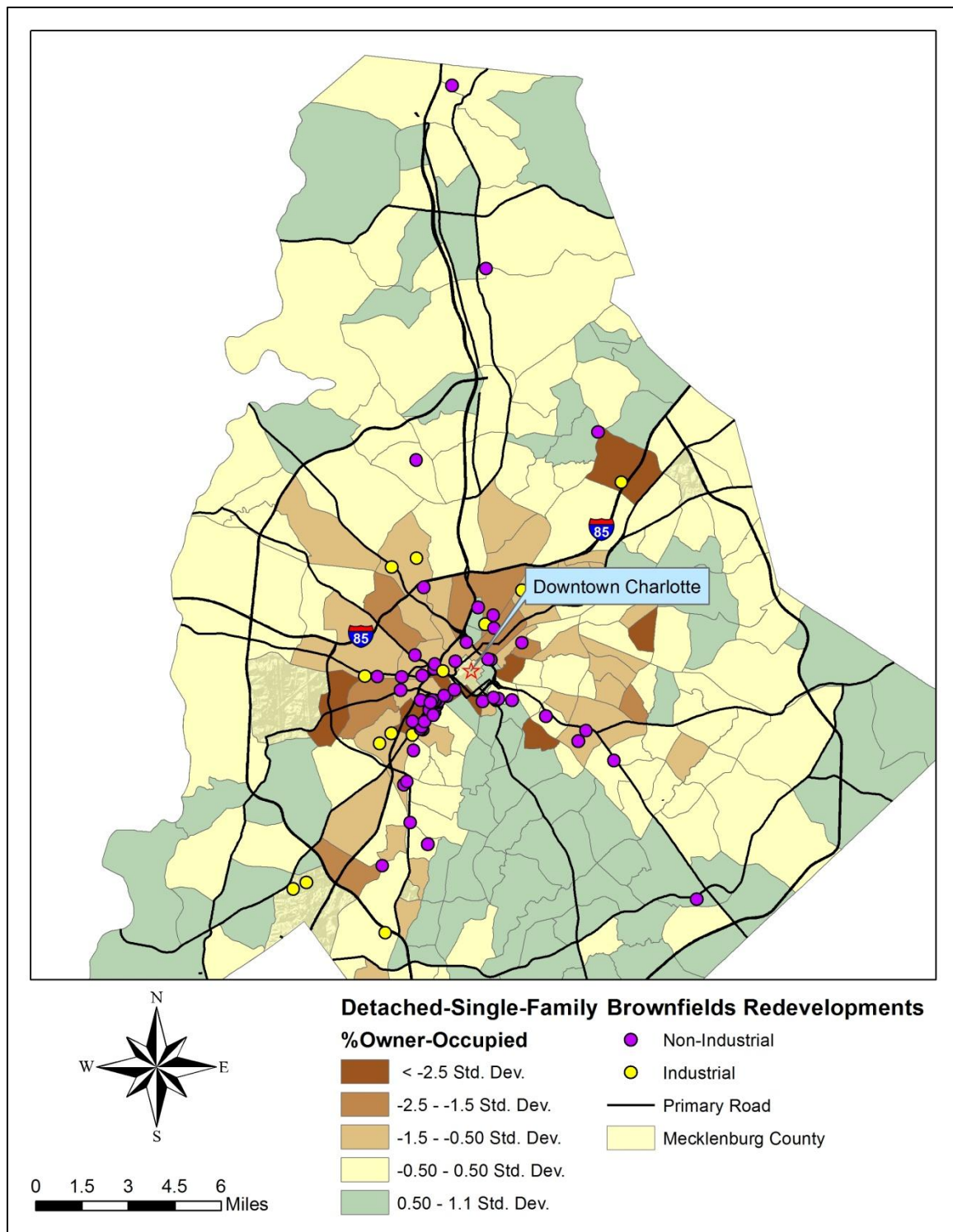


Figure 5: Map of detached-single-family owner-occupancy rates in Mecklenburg County by 2010 census tract.
Source: ACS 2006-2010.

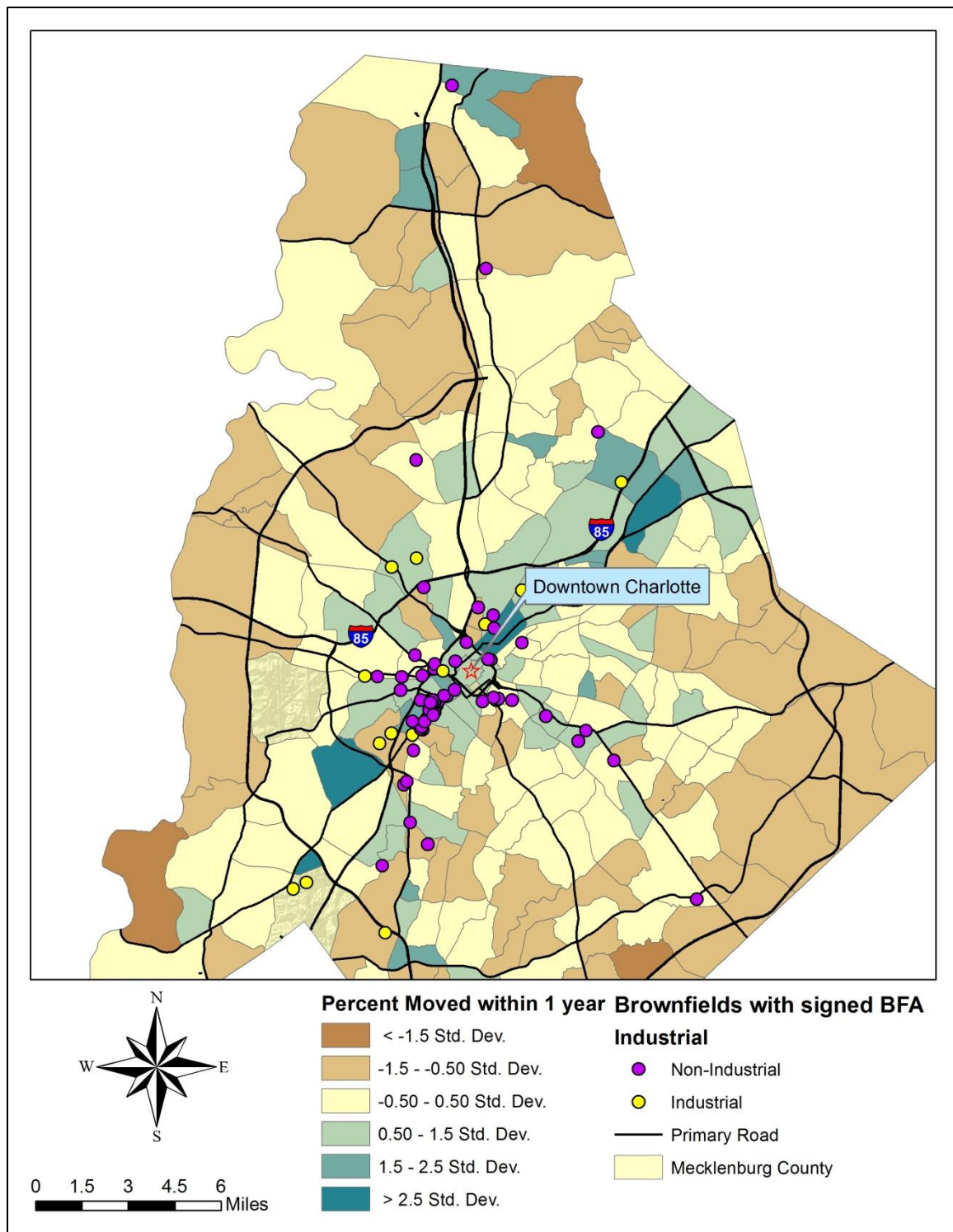


Figure 6: Map of percent of residents who have moved within the past year in Mecklenburg County by 2010 census tract.

Source: ACS 2006-2010

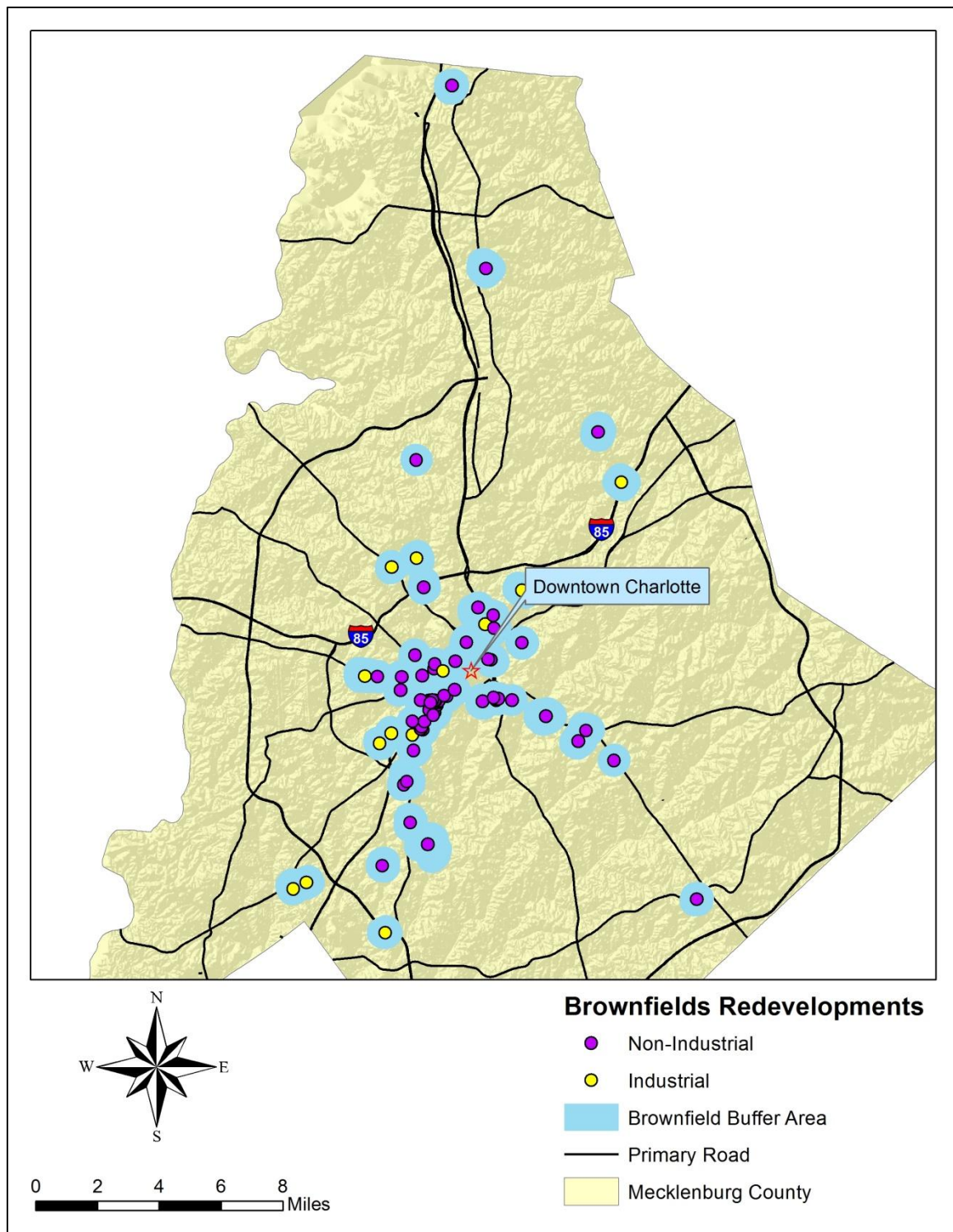


Figure 7: Map of brownfield redevelopments in Mecklenburg County with a half-mile buffer.

4.2: Wake County

Wake County has had substantially fewer brownfield redevelopments since 1998 and consequently has fewer trends to visualize through mapping. Figure 8 shows the dispersion of the redevelopments, eight (8) of them are within the Raleigh beltway and all of them are located on arterial roads. Also seen in figure 8 is the location of the inactive hazardous waste sites. Similar to Mecklenburg County, the inactive hazardous waste sites cluster along the same roads and in the same areas as do the redevelopments, suggesting brownfields are likely to be present in these areas. As delinquent tax information was not available for Wake County it is not possible to make informed speculation about site utilization for the purposes of this study. As will be shown, however, identifiably similar trends exist in Wake County as in Mecklenburg County regardless of the information gap.

Figures 9 and 10 illustrate the redevelopment sites overlain against household income and median home value by tract. In terms of income it is clear that the redeveloped brownfields in Wake County are in areas of below average income. With the exception of the projects located on Highway 70, all the redevelopments are located in or adjacent to a tract below the county average. Both clusters in the inner beltway area are located near tracts of 1.5 or greater standard deviations below the county median indicating a clear differentiation in income. In comparing the income to home value, there is a notable upswing in the median home values of the inner beltway when compared with income deviations. This observation is in line with the disparity of income and home value deviations in Mecklenburg County.

Wake County has a notably consistent high rate of owner-occupancy in detached-single-family homes. Figure 11 shows that, despite this consistency, the brownfields are in and around

the few pockets of lower detached-single-family owner-occupancy rate. Some sites located further from the beltway are exceptions to this. In line with the correlation values seen in table 2, figure 12 shows these same areas around low owner-occupancy areas having high rates of mobility, or a significant number of people having moved recently. Thus brownfield redevelopments in Wake County are occurring in areas with higher rates of resident turnover, as was the case in Mecklenburg County.

These statistics are averages derived from tract-level data and a half-mile buffer based on the area boundary of each redevelopment as shown in figure 13. Table 7 shows the breakdown of the 15 redevelopment sites in Wake County compared to the Wake County averages:

| Wake | Acreage | Mobility | SF, %Owner-Occupied | Home Value | Household Income |
|----------------------------|---------|----------|---------------------|------------|------------------|
| Countywide | * | 18.60% | 88.54% | \$222,300 | \$63,770 |
| Brownfields | 6.47 | 29.43% | 71.96% | \$241,491 | \$48,124 |
| Standard Deviations | * | 0.94 | -1.17 | 0.17 | -0.51 |

Table 7: Area characteristics of brownfield redevelopments in Wake County, NC.

The same trend of positive and negative standard deviations is seen in Wake County as is in Mecklenburg County. Redevelopments appear to be occurring in areas of minor decline both in an economic sense and physical sense. However, looking at the dollar amount in terms of household income, it is an increase from those in Mecklenburg County.

| Wake | Acreage | Mobility** | SF, %Owner-Occupied*** | Home Value | Household Income |
|-----------------------------------|---------|------------|------------------------|------------|------------------|
| Industrial, Average | 0.775 | 19.14% | 84.45% | \$206,627 | \$67,589 |
| Industrial, Deviations | * | 0.05 | -0.29 | -0.14 | 0.12 |
| Non-Industrial, Average | 7.35 | 31.01% | 70.04% | \$246,855 | \$45,129 |
| Non-Industrial, Deviations | * | 1.08 | -1.30 | 0.22 | -0.61 |

Table 8: Industrial and non-industrial property comparisons in Wake County, NC.

*** Significant at the .01 level

** Significant at the .05 level

In looking at table 8 it is important to remember that there are only two industrial redevelopments in Wake County (table 1) thus the validity of the findings is not as significant as it was in Mecklenburg County. Detached-single-family owner-occupancy rates are significantly below the county median around non-industrial properties and are closer to the county median around industrial properties. Interesting to note is the significantly lower acreage with industrial properties. Review of the redevelopment information from NCDENR shows they are restricted to warehouse-type usage; for example, one is stated to cut and store stones and granite countertops. Thus, the industrial uses do not require large acreages. The low acreage is explicable in this situation, but is not seen as significant given the small sample size and current literature. For non-industrial properties in Wake County, the disparity between median home value and household income becomes more significant in non-industrial properties.

Inactive hazardous waste sites in Wake County show significant clustering around existing brownfield redevelopments. In addition to this, the sites are nearly all adjacent to primary roads and follow them between clusters of brownfield redevelopments. Overlain with the selected variables they are found to trend toward lower income areas and also toward lower home value areas, with the exception of the center of the beltway which is slightly above

average in terms of home value. A visual check shows they appear divided between tracts with lower rates of owner-occupancy and those with average. Table 9 shows the statistical breakdown of the area within a half-mile of each of the inactive hazardous waste sites in Wake County, but none are found to be statistically significant as a result of the small sample size:

| Wake | Mobility | SF, %Owner-Occupied | Home value | Household Income |
|--|----------|---------------------|------------|------------------|
| County Median | 18.60% | 88.54% | \$222,300 | \$63,770 |
| IHW Average | 25.90% | 78.65% | \$220,982 | \$53,755 |
| IHW Deviations | 0.64 | -0.70 | -0.01 | -0.33 |
| Diff. in Deviations with Redevelopments | -0.30 | 0.47 | -0.18 | 0.18 |

Table 9: Area characteristics found in a half-mile buffer of inactive hazardous waste sites in Wake County, NC.

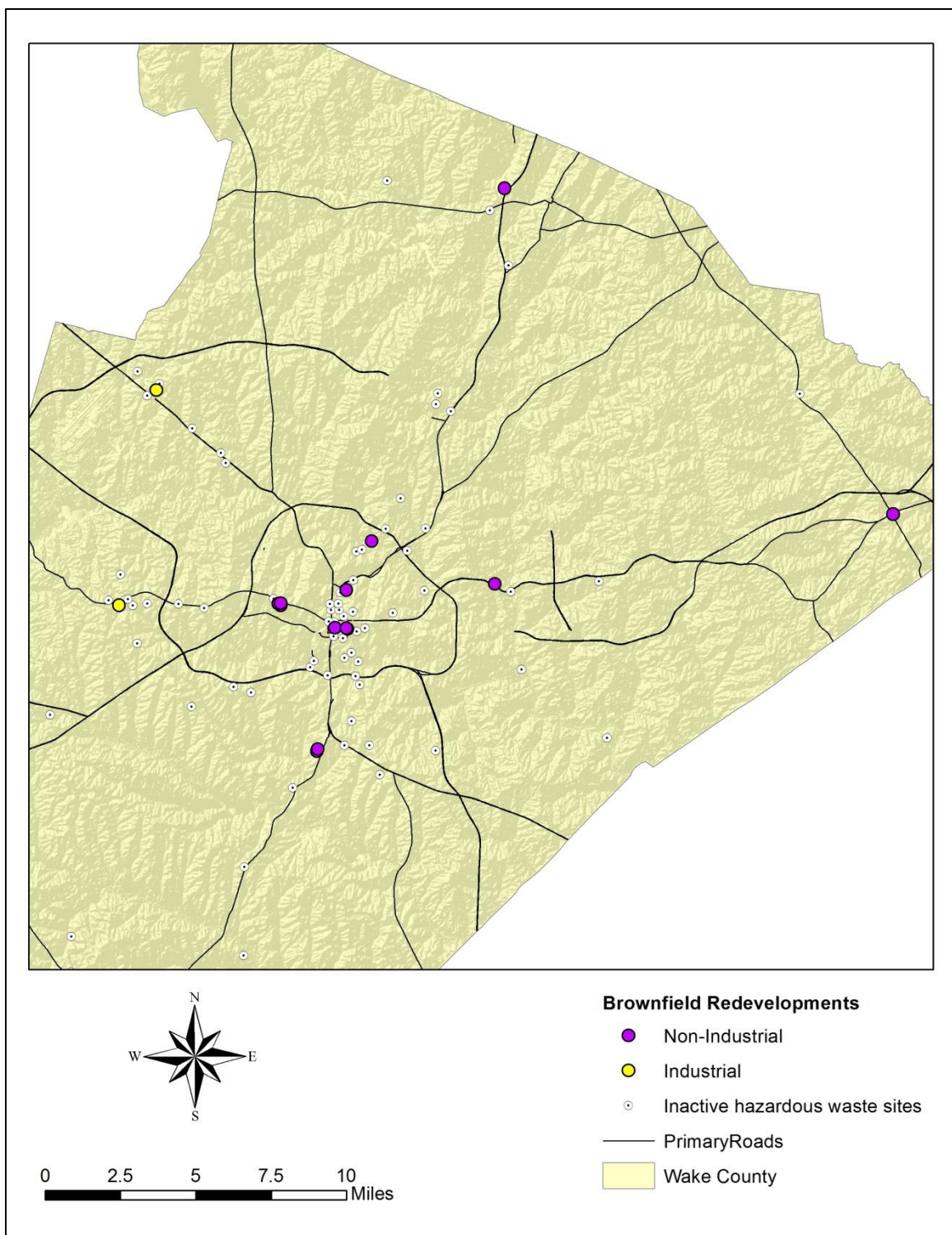


Figure 8: Map of brownfield redevelopments and inactive hazardous waste sites in Mecklenburg County.
Source: NCDENR

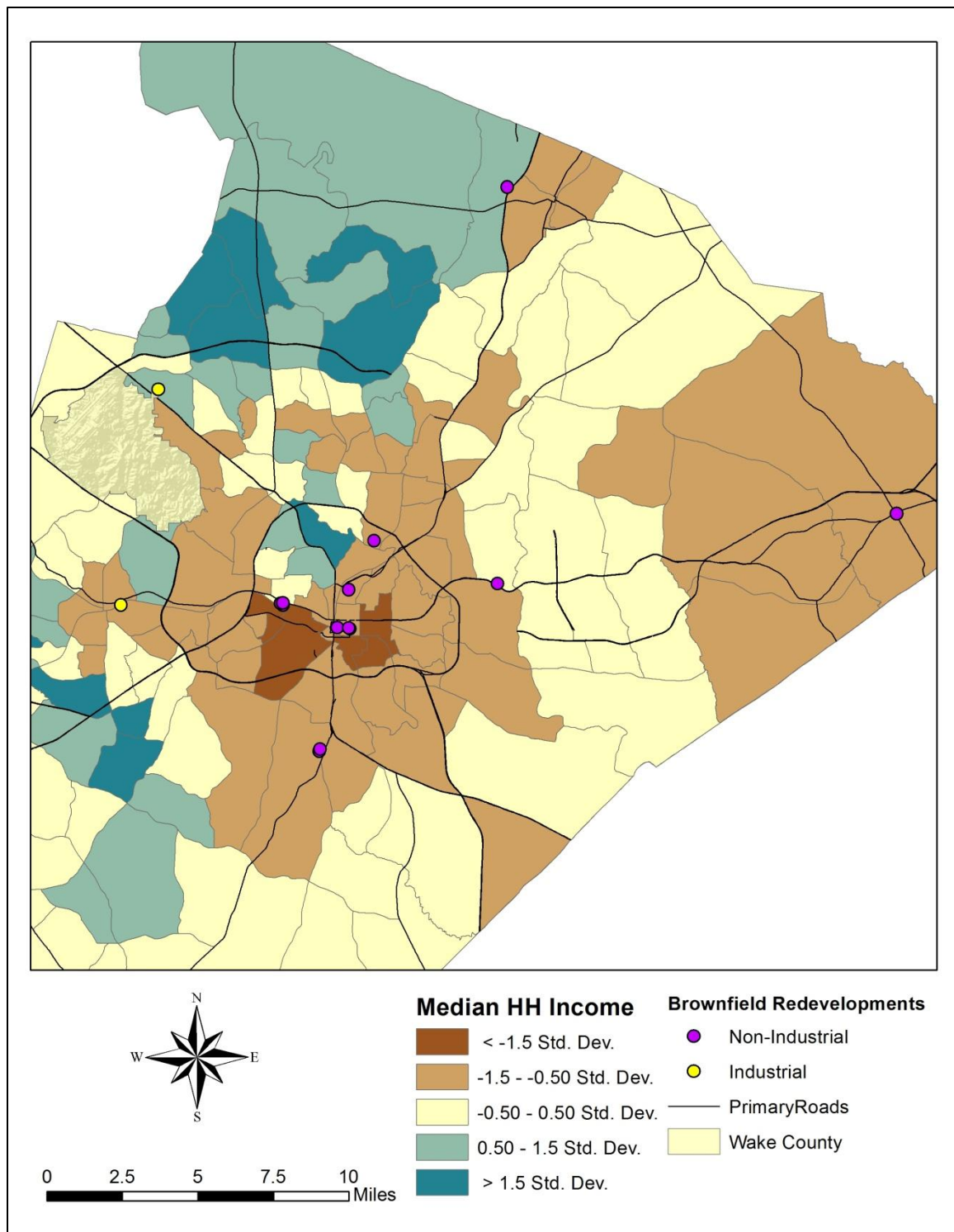


Figure 9: Map of median household income in Wake County by 2010 census tract.
Source: ACS 2006-2010

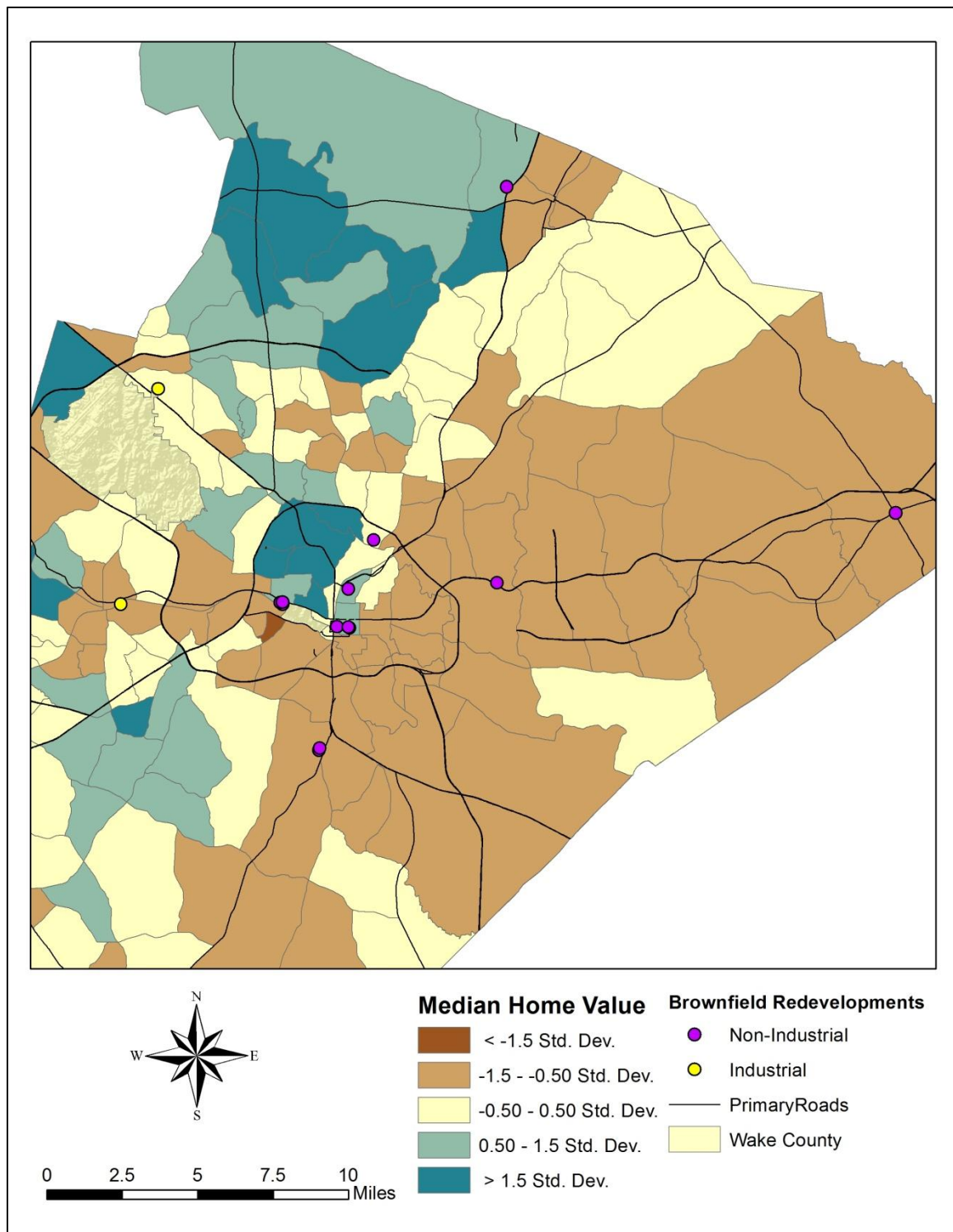


Figure 10: Map of median home value in Wake County by 2010 census tract.
Source: ACS: 2006-2010

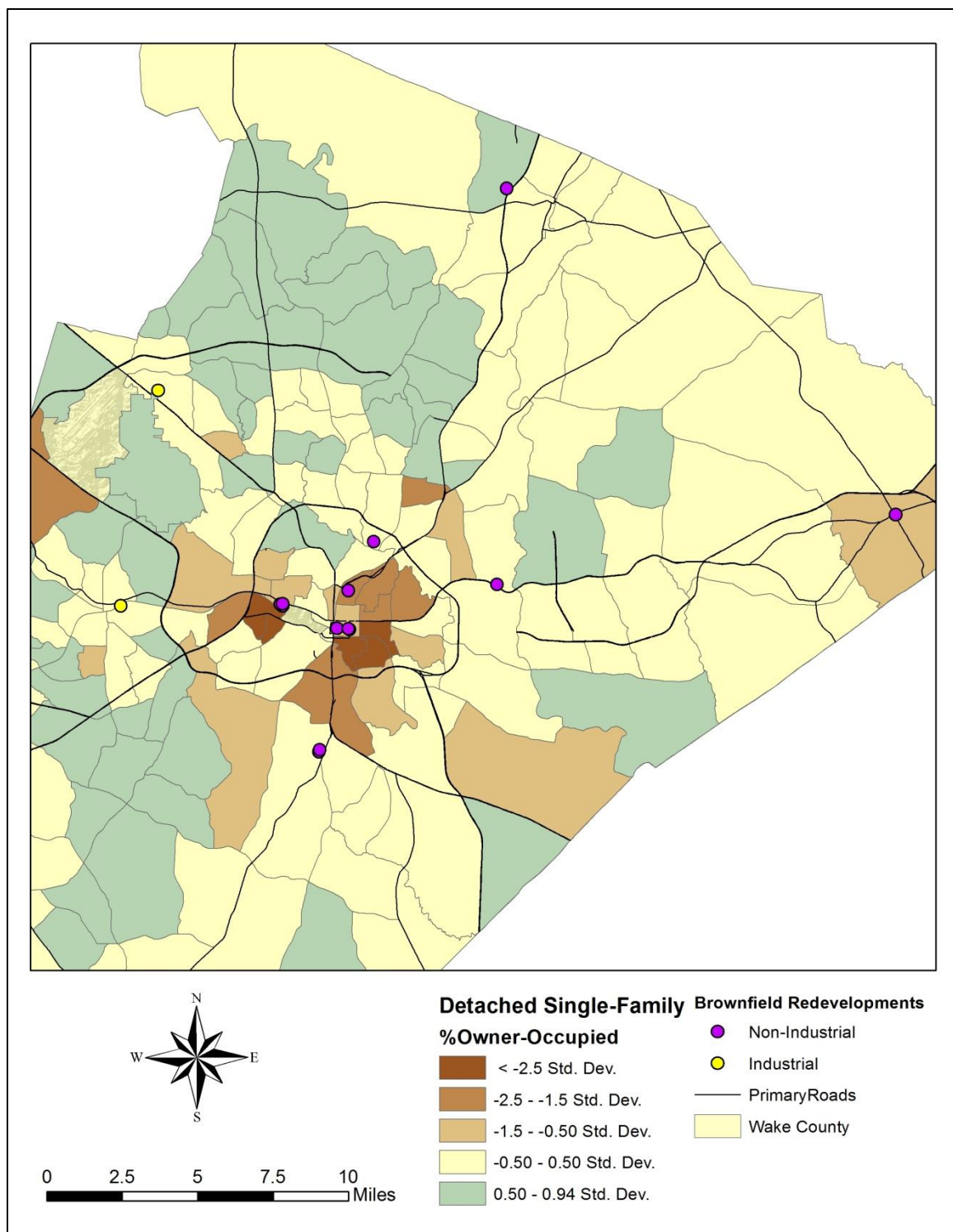


Figure 11: Map of detached-single-family owner-occupancy rates in Wake County by 2010 census tract.
 Source: ACS 2006-2010

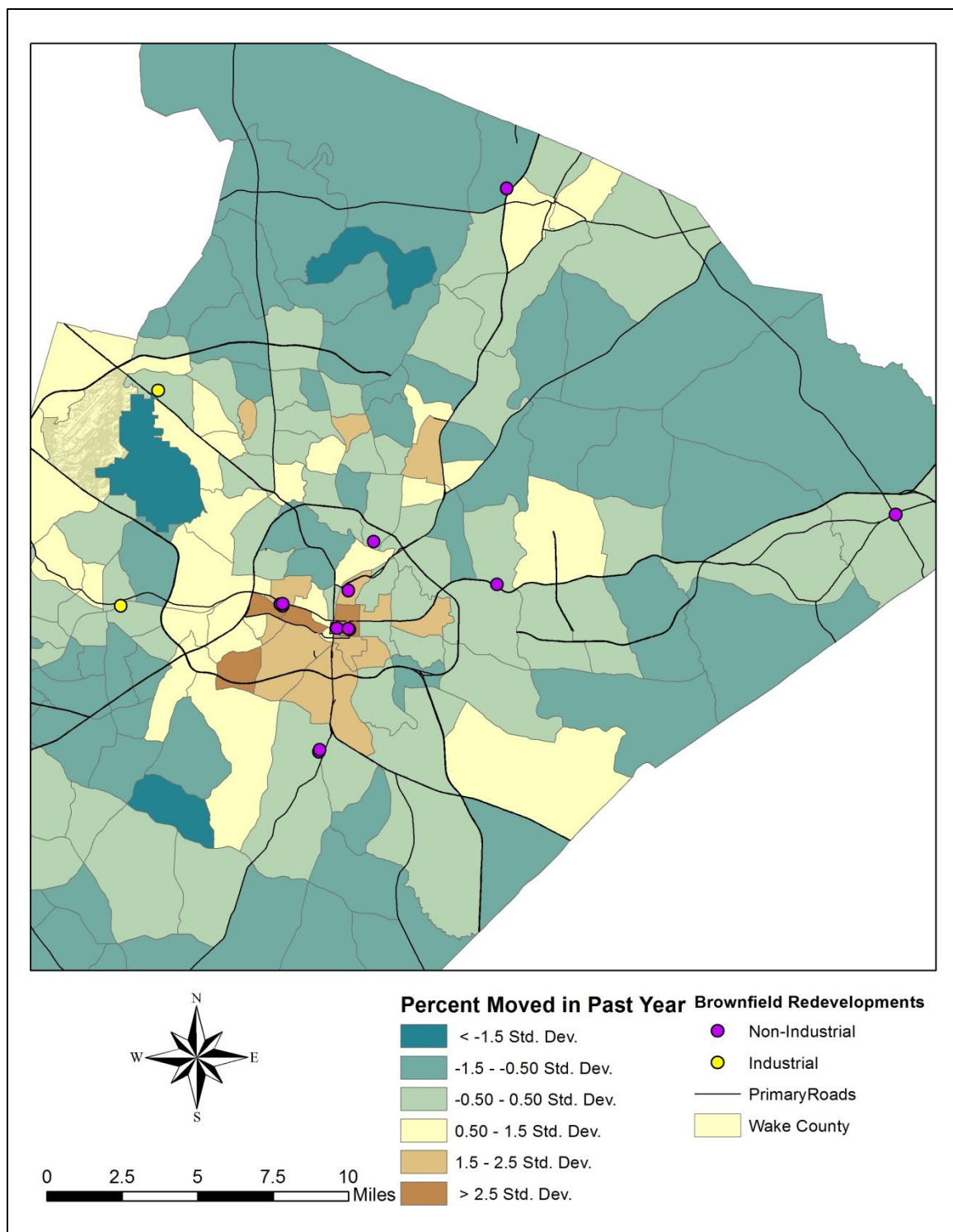


Figure 12: Map of percent of residents who have moved in the past year in Wake County by 2010 census tract.
Source: ACS 2006-2010

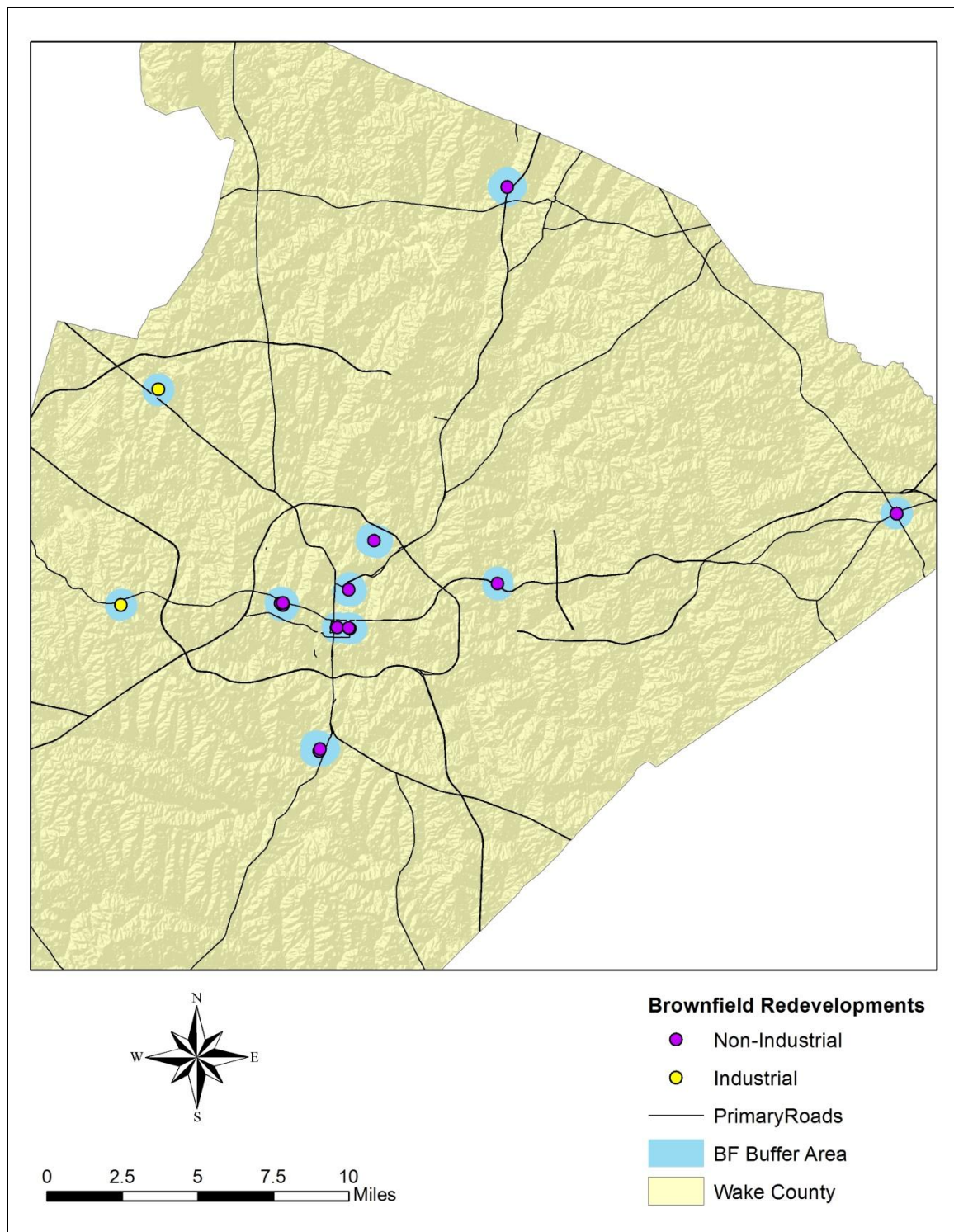


Figure 13: Map of brownfield redevelopments with a half-mile buffer in Wake County.

4.3: Comparison of County Trends

At the county-level trends emerge which will be explored at larger scales. In both counties a disparity in standard deviations of home value and income existed for non-industrial properties, but not for industrial properties in either county. The positive correlation value between these two variables shows a positive relationship, meaning when one increases the other does as well. The relationship in terms of standard deviations shows income levels that are below average in terms of the county and home values that are near the county average. This implies areas where there may be issues in terms of home affordability or people with greater incentive or needing to sell. This notion is reinforced by the consistently above average mobility rates for non-industrial properties, a measure that shows people in the area are physically relocating at approximately 30% per year. While this does include both multi-family and single-family properties, the lower owner-occupancy rates in single-family homes means a higher rental rate suggesting housing mobility may be higher for single-family units as well as multi-family units. Mobility and owner-occupancy rates show significant deviation from the county median adding some validity to the trend.

In terms of acreage between industrial and non-industrial sites, Mecklenburg County is suggested to be of more relevance due to the sample size. In addition to this, the previously discussed uses of the industrial sites in Wake County explain their small size and verify that they are a niche part of industrial developments. Detached-single-family owner-occupancy is a second substantial difference between industrial redevelopments in the two counties. But a comparison of the industrial site locations the two in Wake are both in suburban locations whereas Mecklenburg is mixed of suburban and inner-suburban areas which makes a substantial

difference as to neighborhood conditions. Inner-suburban areas are being expected to have a lower rate of owner-occupied detached-single-family homes.

The inactive hazardous waste site characteristics show comparable trends in both Wake and Mecklenburg Counties. In Mecklenburg, the difference between income and home value standard deviations is reduced from 0.46 to 0.19; in Wake County, the difference drops from 0.68 to 0.32. This drop becomes more dramatic considering the overlap with existing brownfield redevelopments. Tables 10 and 11 show the statistics for inactive hazardous waste sites located more than a half mile from a brownfield redevelopment for both of the counties:

| Wake | Mobility | SF, %Owner-Occupied* | Home Value* | Household Income |
|---|----------|----------------------|-------------|------------------|
| County Median | 18.60% | 88.54% | \$222,300 | \$63,770 |
| IHW Average | 23.36% | 80.69% | \$204,981 | \$56,447 |
| IHW Deviations | 0.42 | -0.55 | -0.16 | -0.24 |
| Diff. in Deviations with Redevelopments | -0.52 | 0.62 | -0.33 | 0.27 |

Table 10: Area characteristics of inactive hazardous waste sites more than a half-mile from a brownfield redevelopment.

* Significant at the .10 level

| Mecklenburg | Mobility*** | SF, %Owner-Occupied*** | Home Value** | Household Income*** |
|---|-------------|------------------------|--------------|---------------------|
| County Median | 21.80% | 85.18% | \$185,100 | \$55,294 |
| IHW Average | 22.49% | 75.50% | \$160,911 | \$49,000 |
| IHW Deviations | 0.06 | -0.61 | -0.19 | -0.22 |
| Diff. in Deviations with Redevelopments | -0.61 | 0.59 | -0.20 | 0.23 |

Table 11: Area characteristics of inactive hazardous waste sites more than a half-mile from a brownfield redevelopment.

*** Significant at the .01 level

** Significant at the .05 level

Looking at the inactive hazardous waste sites a half-mile away from brownfield redevelopments shows that the household income and home value standard deviations are almost matching implying a more traditional relationship between income and home value. Pairing this with the previously observed rise in disparity in non-industrial redevelopments strongly suggests that brownfield redevelopments occur in areas where household income is lower than would be expected when compared to home values. The relationship is with property values is significant in both counties and there is a strong statistical significance with both income and home values in Mecklenburg County.

4.4: Tapestry

ESRI Tapestry Segmentation is a neighborhood classification method for classifying neighborhoods as one 65 types based on a broad range of socioeconomic and demographic data. Table 12 provides a brief description of the three primary segment groups used in the analysis. In the appendix is a table that has a description of all 12 segment groups.

| Tapestry Segment Group | Description |
|-------------------------------|---|
| Metropolis | City dwellers who live in older, single-family homes. Uniquely urban, they range from welfare recipients to decently wealthy, well-educated persons. |
| Solo Acts | Mostly young, professional singles that prefer city life who typically populate the densest neighborhoods. Often either attending college or already graduated. |
| Family Portrait | Young families who have school-aged children. This is one of the fastest growing segment groups. |

Table 12: Key ESRI Tapestry segment groups.
Source: ESRI

The groupings provide insight as to the economic lifestyle and living characteristics of consumers and residents of an area. The data is aggregated from the US Census Bureau as well as private sector research sources such as consumer preference surveys. Segment groups are used in a broad sense in order to discuss the markets and consumers that comprise the neighborhoods surrounding brownfield redevelopments.

For this analysis tapestry segmentation was studied at both the tract-level through ESRI Business Analyst and at the site-level through Site To Do Business. At the tract level, data was sorted into the 12 tapestry segmentation summary groups. At a county-level analysis they provide a look at how brownfield redevelopments fit into socioeconomic fabric of the area. Figures 14 and 15 show the brownfield redevelopments overlain against the tracts showing their segmentation groups. Solo Acts, Metropolis, and Family Portrait are the dominate groups and the only to have more than 10% of all redevelopments at the tract-level.

Table 13 shows the neighborhood characteristics of brownfield characteristics that share tract-level classification by market classification. In discussing these groups, it is beneficial to consider metropolis and solo acts together due to similarities in characteristics affecting neighborhood development. Metropolis is larger due to the geographical location of brownfields and thus redeveloped brownfields. They are people that prefer to live in older, urban neighborhoods or are lower-income residents found in rundown, urban neighborhoods. Solo acts are younger, white-collar residents who typically don't have families and are considerably more mobile. They are entrepreneurs who prefer high-density residential areas, mixed-use environments and are typically career-oriented, educated persons. Both of these segments are frequently renters, thus it is feasible for a metropolis neighborhood to transition to a solo acts neighborhood. Possible reasons are that these real estate markets are already geared towards

renters and a lower quality of schools may be of less importance to solo acts as they have a low proportion of households with children.

| Segment Group | Count | Percent of Projects | Acreage | Mobility | Home Value | SF, %Owner-Occupied | HH Income | Industrial Sites |
|---------------------|-------|---------------------|---------|----------|------------|---------------------|-----------|------------------|
| High Society | 2 | 2.3% | 23.12 | 0.11 | 0.78 | 0.07 | 0.85 | 0 |
| Upscale Ave. | 6 | 6.9% | 11.04 | 0.44 | -0.31 | -0.78 | -0.10 | 3 |
| Metropolis | 20 | 23.0% | 5.31 | 1.25 | -0.05 | -1.87 | -0.68 | 2 |
| Solo Acts | 17 | 19.5% | 9.03 | 0.41 | 0.49 | -0.73 | -0.24 | 0 |
| Senior Styles | 8 | 9.2% | 5.74 | 1.47 | 0.82 | -1.88 | -0.51 | 1 |
| Scholars & Patriots | 0 | 0.0% | N/A | N/A | N/A | N/A | N/A | 0 |
| High Hopes | 5 | 5.7% | 11.38 | 0.13 | -0.27 | -0.53 | -0.59 | 1 |
| Global Roots | 1 | 1.1% | 16.25 | 0.66 | -0.79 | -1.23 | -1.14 | 1 |
| Family Portrait | 20 | 23.0% | 10.45 | 0.75 | -0.20 | -1.25 | -0.51 | 3 |
| Traditional Living | 7 | 8.0% | 22.84 | -0.01 | -0.43 | -0.72 | -0.65 | 4 |
| Factories & Farms | 1 | 1.1% | 1.75 | -0.28 | -0.80 | -0.81 | -0.73 | 0 |
| American Quilt | 0 | 0.0% | N/A | N/A | N/A | N/A | N/A | 0 |

Table 13: Area characteristics of and number of redevelopments by tapestry segment group.

Table 14 shows the subgroups that feature brownfield redevelopments within the metropolis and solo acts market segments. The table orders the subgroups by income thus metropolitans and laptops and lattes feature the higher income of metropolis and solo act subgroups respectively.

| Metropolis | Num. of Projects | Solo Acts | Num. of Projects |
|---------------------|-------------------------|--------------------|-------------------------|
| Metropolitans | 5 | Laptops and Lattes | 2 |
| Metro City Edge | 12 | Metro Renters | 8 |
| Modest Income Homes | 3 | Old and Newcomers | 5 |
| | | Young and Restless | 2 |

Table 14: Subgroups for metropolis and solo acts segment areas.

Metro city edge and modest income neighborhoods are substantively lower income areas compared to the corresponding solo act subgroups. They are signified by a disproportional number of residents receiving public assistance, above average unemployment, and shopping at discount or secondhand stores. The wealthier subgroup of this segment, metropolitans, is the metropolis population in Wake County whereas the other two are only in Mecklenburg County. Metropolitans are characterized by a high labor force participation rate, an urban lifestyle, high-education, and a significant counterculture element. These are areas of slow change and higher wealth. Here redevelopments may occur as a result of the lifecycle of buildings. They may become obsolete and then renovated as opposed to abandoned and redeveloped. Areas surrounding the metropolis tracts in Wake County where the redevelopments are located lean toward areas that fall into the solo acts market segmentation as is the case in Mecklenburg County for a significant number of redevelopments located in metropolis tracts. This means these areas have elements of or are best described as dense, urban neighborhoods that have been maintained and where younger, urban individuals have moved.

Solo act subgroups are all related by youthfulness, higher educational attainment, beginning a professional career, and singlehood with no children. Their lives are conducive to apartment rental; they are noted for living an urban life, preferring to work out in clubs; they also utilize the internet with greater frequency and are more technologically savvy. The

neighborhoods they occupy are constantly changing and evolving. Comparing metropolis to solo act segments, the location and density of their neighborhoods is expected to be similar. Looking again at the tapestry maps, solo acts is an underrepresented summary group as the projects are aggregated based on the tract they occurred in; many of these redevelopments are located a half-mile or closer to solo acts tracts, suggesting they may share characteristics with that market segment. Given this proximity, the difference in wealth, and similarities in lifestyle, solo acts may be seen as the market segments that emerge as a result of redevelopment and consequently gentrification of areas.

In terms of industrial and non-industrial sites, the fact that upscale avenues, the second wealthiest overall segment, has seen three (3) properties redevelop into industrial sites, or half of all redevelopment projects, is unexpected. A closer look reveals two (2) of these are the industrial sites which occurred in Wake County and have been previously noted as being light-industrial and less hazardous in nature. The one (1) in Mecklenburg County is noted as being light industrial and office usage. Thus these industrial projects in wealthier areas are explained by their being light-industrial in low-density areas where they are not likely to conflict with residential development.

Family portrait is a third tapestry group that appears conducive to brownfield redevelopment. The reason is related to how this segment group is closely integrated with the metropolis segments in terms of geography. These areas typically have larger households and are composed of homeowners in single-family homes. A breakdown of the segments within family portrait areas shows they are all concentrated in two (2) of five (5) segments:

| Family Portrait | Projects |
|-------------------------------|-----------------|
| Up and Coming Families | 5 |
| City Commons | 15 |

Table 15: Subgroups for family portrait segment group.

These two segments are separated mainly by income level and family structure. The first group is up and coming families and is identified by affluence, a high labor force participation rate, and a traditional family-consumer behavior. The latter group is identified as including a disproportionate number of single-parents, being younger, and dependent on public assistance. They are similar to some metropolis segments in terms of their socioeconomic vulnerabilities. Furthermore, a survey of the five projects in tracts dominated by the up and coming families segment shows they are isolated industrial developments, or expansions of pre-existing office and commercial developments.

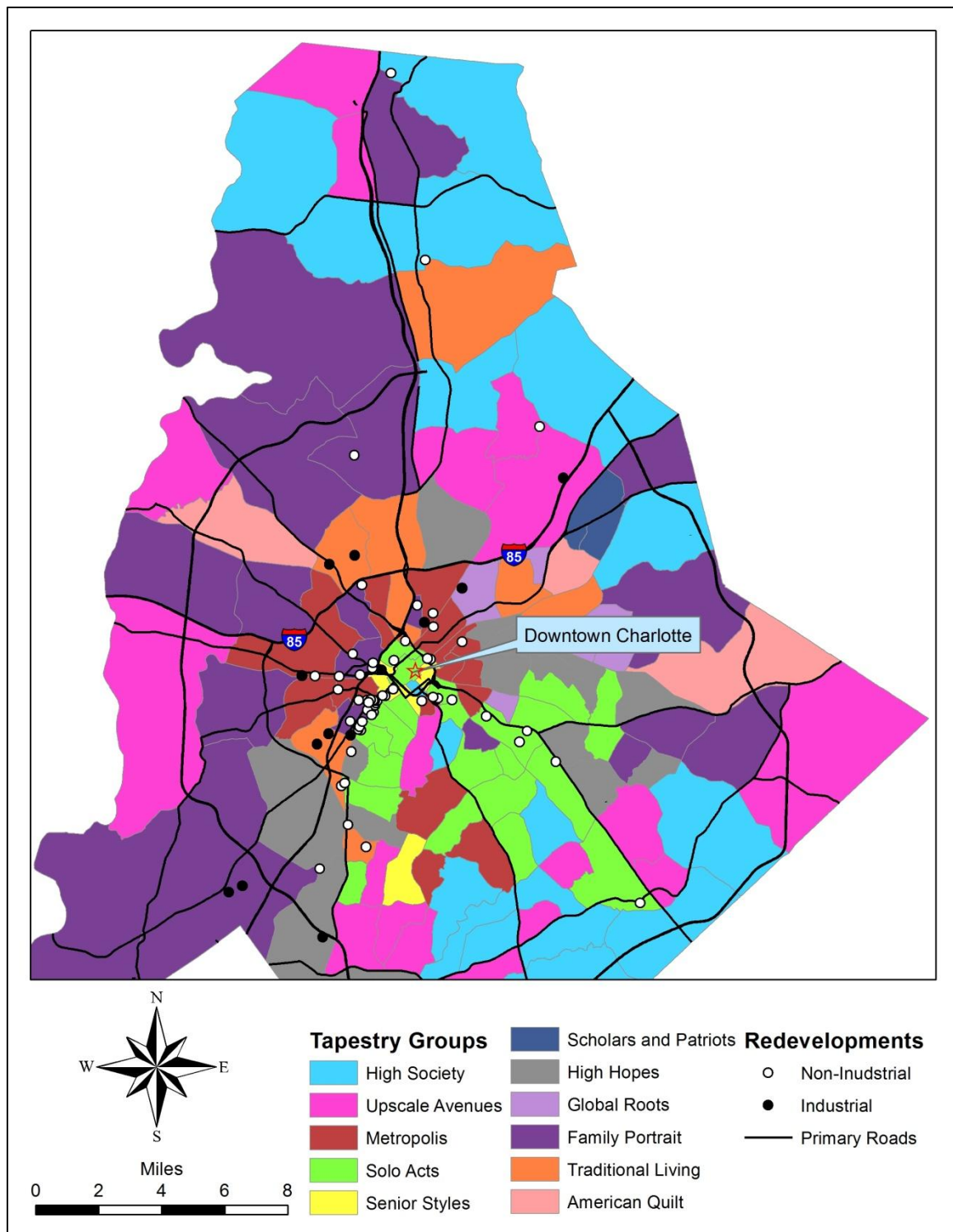


Figure 14: Map of tapestry segmentation in Mecklenburg County.
Source: ESRI Tapestry

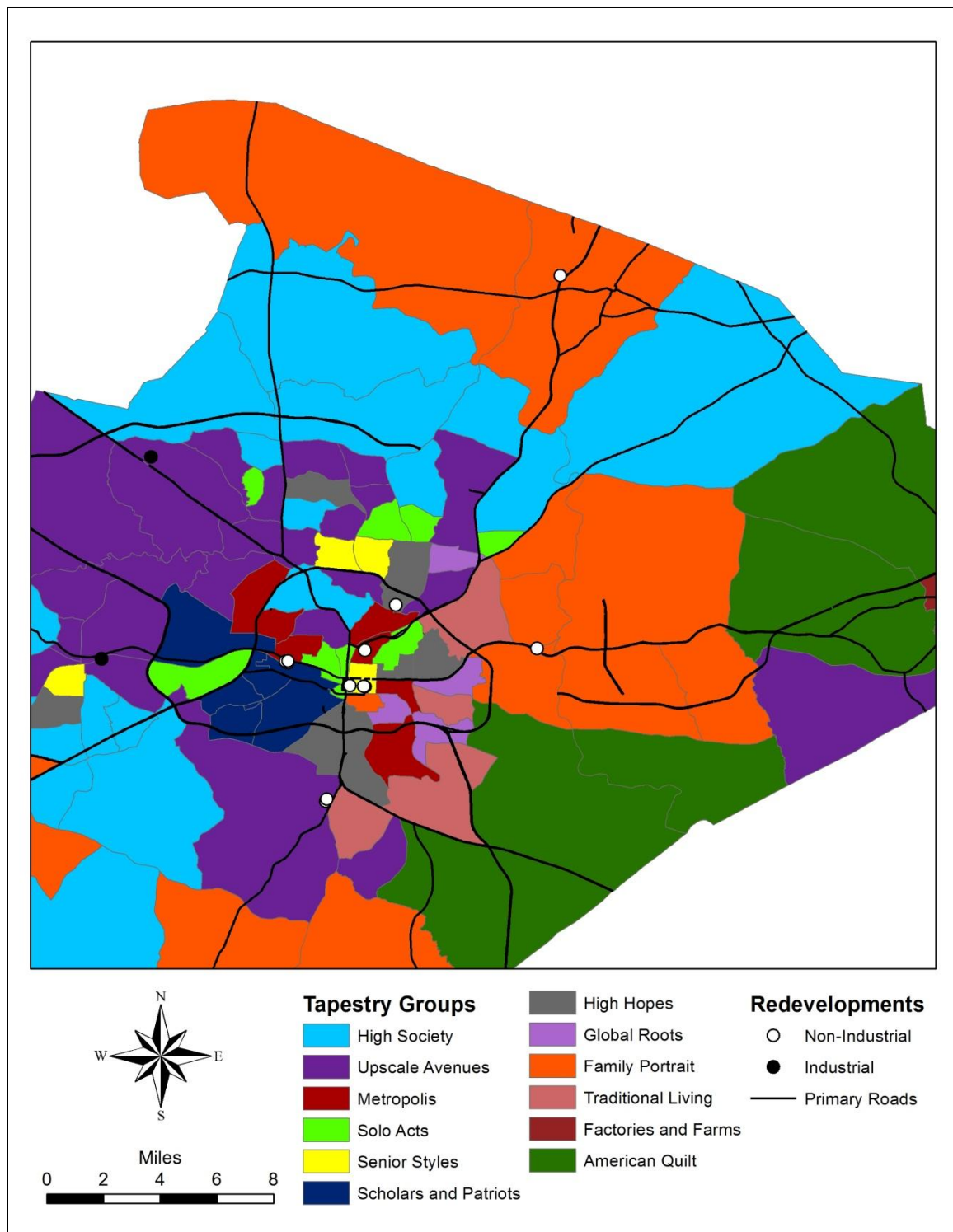


Figure 15: Map of tapestry segmentation in Wake County.
Source: ESRI Tapestry

4.5: Charlotte Light Rail and Heritage Street Car Influence

In looking at a map of the location of light rail and street car stations in Mecklenburg County there is a visible correlation between their location and brownfield redevelopments. Eighteen (18) redevelopments are within a one-quarter mile of a station and 27 are within a half-mile (table 16). These redevelopments are of greatest frequency along South Boulevard approaching downtown, but continue for the length of the transit system. The reasons for this are both historical and economic. Brownfields are frequently located near railroads as they tend to be old industrial properties; the Charlotte system utilizes existing railway and thus was likely to be located near brownfield sites.

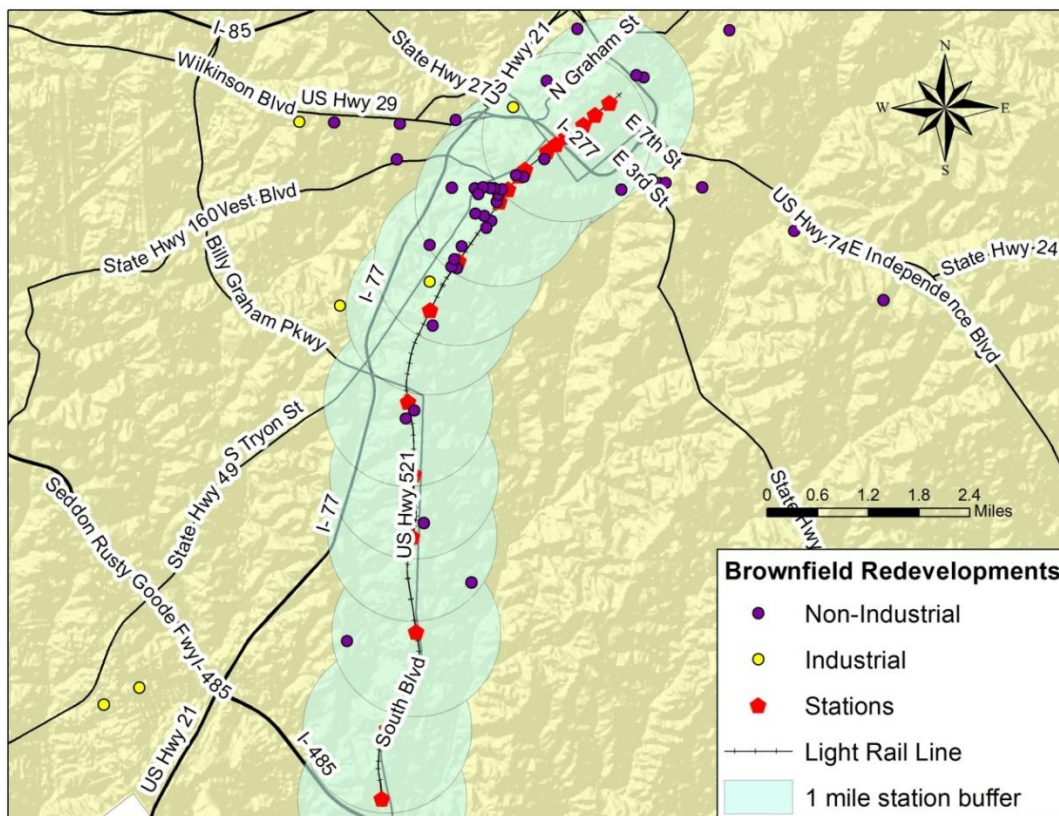


Figure 16: Map of brownfield redevelopments in Mecklenburg County in relation to LRT stations.

Economically, light rail has the potential to lead to increased redevelopment demand as property values rise. One reason for this is once a site is selected as a light rail or street car station it is unlikely to change due to the high cost involved. A second reason is the nature of who is attracted to urban areas as was shown with tapestry segmentation. Areas where brownfields redevelop have a propensity to attract independent, younger entrepreneurs who are white-collar and work in the central business district. The Charlotte street car operates on 15-minute weekday and 30-minute weekend headways while the light rail system does roughly the same but offers 7.5-minute headways during peak commute times. This system is conducive to commuting travelers to downtown Charlotte and thus would assist in making an area attractive to the same people that are already attracted to neighborhoods where brownfield redevelopments exist.

Past research has shown that light rail stations increase both overall property and land values regardless of zoning densities and in numerous locations (Knaap & Ding & Hopkins, 2001; Cervero and Duncan, 2002; Hess and Almeida, 2007). Vacant land values in Washington County, Oregon were found to have increased substantially a half-mile from the announced locations of new light rail stations the year of and years following the date of the announcement (Knaap & Ding & Hopkins, 2001: 36). Cervero and Duncan (2002: 12-14) found that in Santa Clara County, CA, commercial property values increased within a 5-minute walking distance, or approximately a quarter-mile, from new light rail stations. Hess and Almeida (2007: 1057) compared the effect of a half-mile distance in terms of Euclidean-distance and by the road pattern and found that in both instances property values increased with the greater increase being found in properties aggregated by Euclidean-distance. They have minimal discussion as to why the distance according to the road pattern would have less of an impact than the perceived distance as

displayed by Euclidean-distance. However, a hypothesis is that the connection to a light rail station is considered a general locational advantage to the area, even if it is just perceived. Essentially, their findings quantify the element of speculation in addition to a real increase in property values in relation to light rail stations. Increasing property values through light rail development and speculation may be important to brownfields for the additional reason that it may increase surrounding property values. In the case of otherwise upside-down sites, this increase can make a site feasible for redevelopment barring a holdout barrier situation.

Almost half of the brownfield redevelopments in Charlotte are within a mile distance of a Charlotte light rail or street car station. Additionally, a disproportional number of these redevelopments are for non-industrial uses. Industrial uses account for 18% of all county redevelopments, but this drops to 0%, 8%, and 12% of projects within a quarter-mile, half-mile, and one-mile distance of a light rail station respectively.

| Distance from Station | 0.25mi | 0.5mi | 1mi |
|-----------------------|--------|-------|-----|
| Non-Industrial | 18 | 25 | 34 |
| Industrial | 0 | 2 | 4 |

Table 16: Number of brownfield redevelopments within a specified distance of Charlotte light rail and street car stations.

Access to the light rail stations can increase traffic to sites making it a desirable location for commercial sites. For residential uses, the light rail creates a perception of connection and accessibility serving as a point for development to focus around. Additionally, public transit users consist of lower wage earners but also younger professionals, the two main market segments found in the neighborhoods where a larger proportion of brownfield redevelopments are occurring.

4.6: Site Visits

As part of the analysis areas of redeveloped brownfields and areas void of them were visited to identify qualitative aspects. The main tie together found was access but in a specific sense was the quality of design and perceived economic health of the primary arterial road the site was anchored to. Additionally, the site visits cast doubt on the ability of remediating brownfields to solely ignite change in the immediate area. Non-industrial brownfield redevelopments occurred on arterials with positive development patterns already in place and avoided disparate corridors in terms of developments where people would live or shoppers would frequent. The visits were done only at Mecklenburg County sites due to budget and geographic limitations, however, internet resources were used to explore Wake County sites. For Mecklenburg, five areas of brownfield redevelopments will be discussed: Camden Square in between South Boulevard and South Tryon Street, redevelopments in the so-called East Park Redevelopment Zone, two redevelopments off Summit Avenue near West Morehead Street, Hutchinson Shopping Center, and an industrial redevelopment at the south end of the county off Westinghouse Boulevard.

4.6.1: *Camden Square*

Camden Square is a 0.89 acre mixed-use redevelopment with a cleanup agreement signed in 1998 that is geographically an anchor for numerous other redevelopments that have occurred around the Atherton Mills Station along the Charlotte heritage street car line. Across the street from Camden Square is the Ashton South End luxury apartment complex redevelopment that is ten stories of high density residential development. In addition to this,

Camden Square has expanded to include its own high density residential element as well as several other mixed-use and high density residential developments. While the projects are located between South Boulevard and South Tryon Street it is clear the development exists because of South Boulevard. Pedestrian comfort and urban design quality diminishes as you walk towards Tryon Street. Furthermore, traffic flows from collector streets to South Boulevard and rarely to Tryon Street. In the Camden Square addition, the residential development closest to Tryon, the design is clearly one to allow residents to ignore Tryon should they choose.

Tryon Street includes many abandoned buildings and empty lots. There is one office complex that has emerged and happens to be a brownfield redevelopment. However, the office is a condo showroom and not intended to have foot traffic or engage the surrounding area. During my visit I witnessed several homeless individuals wandering gravel lots drinking, numerous abandoned buildings that clearly were broken into repeatedly, and the only sign of activity was a gas station. This is compared to Camden Square which had dozens of people eating outside and South Boulevard where there was heavy traffic and numerous active businesses. West Boulevard had a similar divide; there you can stand and see maintained, active development looking south towards Camden Square and decayed structures with obtrusive security features looking north. In driving away, Tryon Street becomes densely developed and of increasing quality approaching downtown; but at Camden Square it is clearly the commercial activity of South Boulevard that provides the incentive to invest in these underutilized sites. Below are two statistical breakdowns, one is for the Camden Square redevelopment and the other includes Camden Square as well as adjacent redevelopments in the area:

| Camden Square | Acreage | Mobility | SF, owner-occupied | Home Value | Household Income |
|----------------------------|---------|----------|--------------------|------------|------------------|
| Value | 0.89 | 35.90% | 61.26% | \$254,989 | \$52,224 |
| Standard Deviations | * | 1.19 | -1.52 | 0.55 | -0.11 |

Table 17: Average area characteristics of Camden Square.

| Camden Area | Acreage | Mobility | SF, owner-occupied | Home Value | Household Income |
|----------------------------|---------|----------|--------------------|------------|------------------|
| Average | 2.27 | 36.89% | 60.06% | \$213,148 | \$46,627 |
| Standard Deviations | * | 1.28 | -1.59 | 0.22 | -0.30 |

Table 18: Average area characteristics of Camden Square and surrounding redevelopments.

In comparing the two we see that Camden Square (and consequently Ashton South End) is weighted towards the area with higher home values and higher incomes. Detached-single-family owner occupancy rates remain relatively constant as does the percentage of people who have moved in the past year. Additionally, we see the income and home value disparity increase in terms of standard deviations. By contrasting Camden Square and the adjacent redevelopments, including those that are either not customer-oriented or designed to exclude the surrounding area, we see the areas imbalance in terms of home value and income remains in the area surrounding the redevelopments.

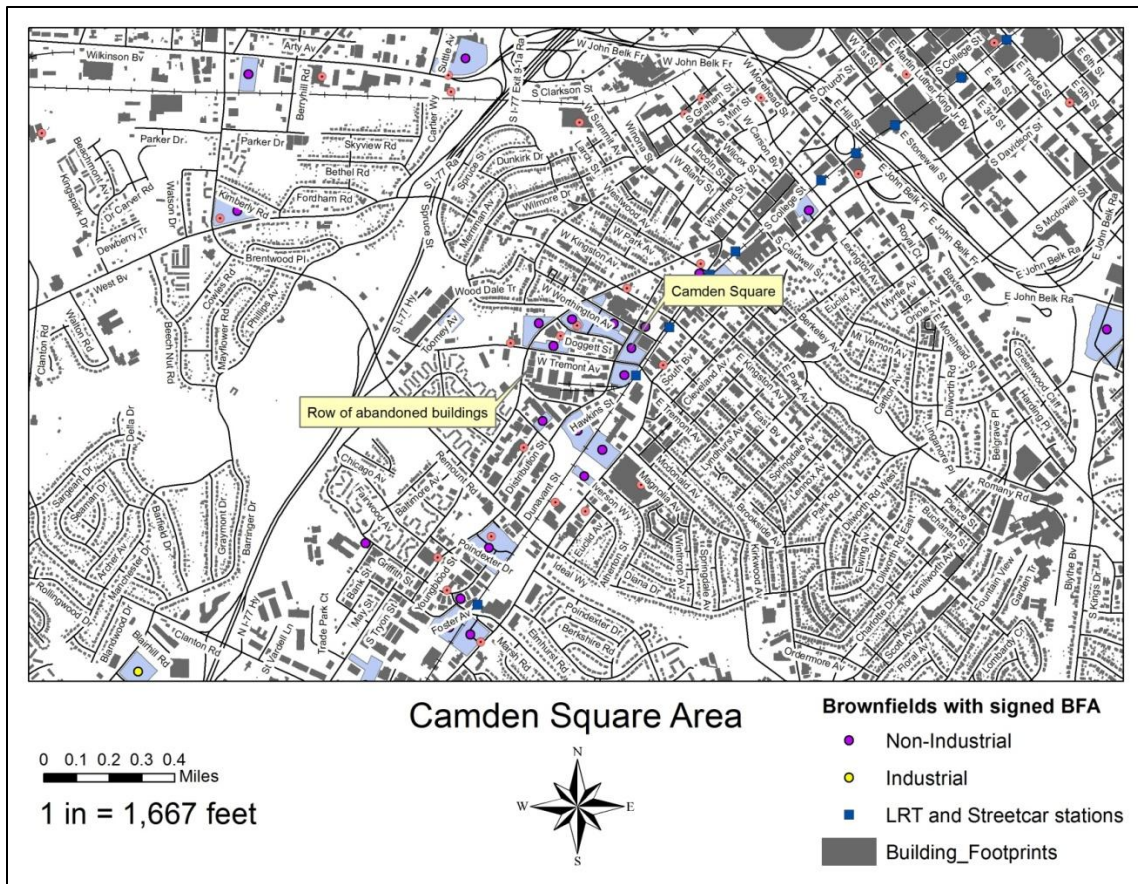


Figure 17: Map of Camden Square area.



Figure 18: Row of abandoned buildings on South Tryon approximately a quarter-mile from Camden Square (left). An undeveloped brownfield site one (1) block away from Camden Square (right).

As part of the site-level analysis, tapestry segmentation was found using Site To Do Business for a half-mile Euclidean-buffer of the street address. Table 19 shows the breakdown for Camden Square. The redevelopments in this area illustrate the combined significance of solo acts and metropolis segments, as they both account for roughly 42% of the immediate area population. Upon the site visit, pedestrians and customers at Camden Square businesses were clearly younger, drove newer vehicles, and appeared to be economically well-off. Residents viewed off South Tryon Street were likely near or below the poverty line, older, drove older cars, and wore lower quality clothing.

| Life Mode Segment | Tapestry Segment | Percent |
|----------------------|---------------------|---------|
| Solo Acts | Laptops and Lattes | 42.3% |
| Metropolis | Metro City Edge | 34.4% |
| Senior Styles | Social Security Set | 14.8% |
| Metropolis | City Commons | 7.7% |
| Metropolis | Metropolitans | 0.9% |

Table 19: Tapestry segments represented within a half-mile of Camden Square.

4.6.2: East Park

East Park is an area south of Downtown Charlotte that has seen significant redevelopment. There are rail tracks laid down the middle that do not currently link to the light rail system in addition to other streetscape improvements. Elizabeth Avenue down the center is a pedestrian-friendly street that links to downtown as well as to 4th Street (through Hawthorne Lane) which accommodates thru-traffic. The area has good access to downtown, the interstate, and stadium areas. There is also a hospital in the area at the end of Elizabeth Avenue. The redevelopments in East Park are less notable than Camden Square. They include a pregnancy resource center,

parking garage, corner restaurant, a Burger King, and an office building. The redevelopments, according to NCDENR, were done as part of a redevelopment zone between 2003 and 2004.

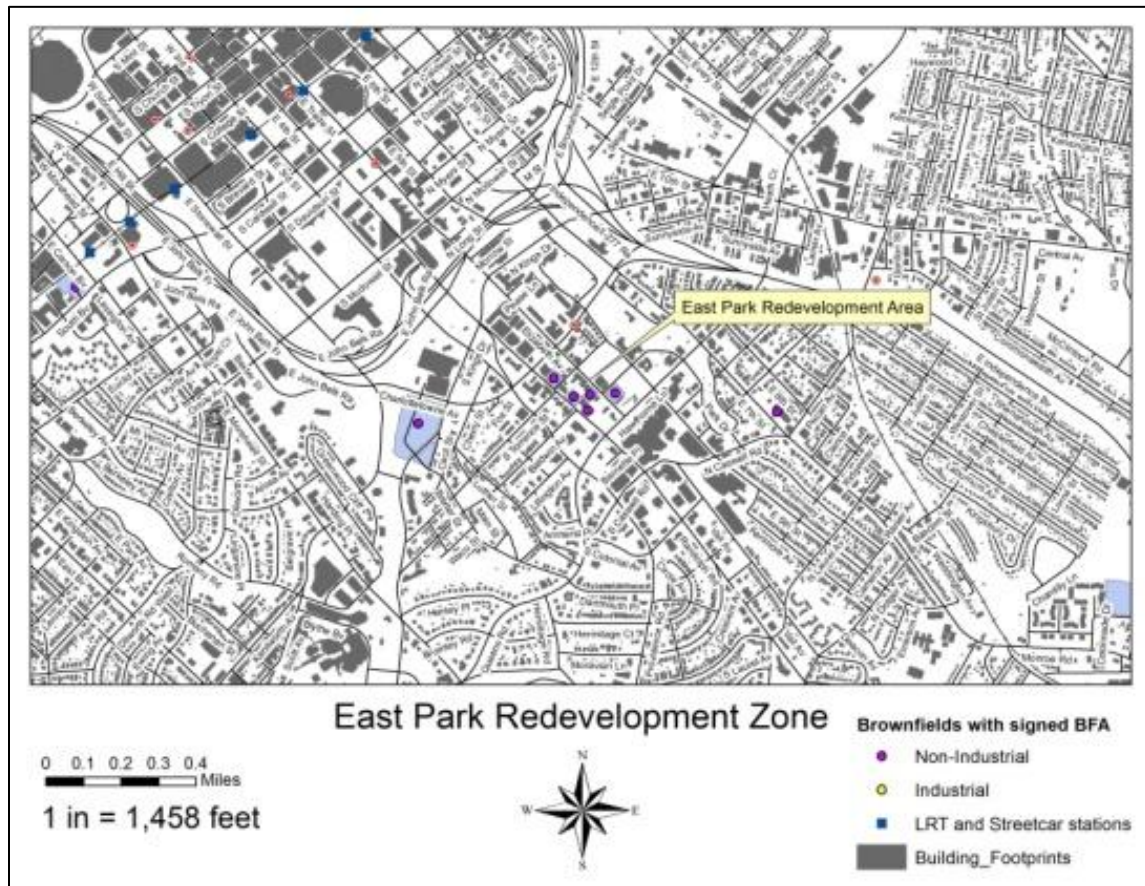


Figure 19: Map of East Park area.

Elizabeth Avenue is a neighborhood center and includes active dining and retail establishments. 4th Street includes mostly strip retail and signs of existing decline. Adjacent to the redeveloped brownfields off 4th Street two dry cleaners stand abandoned on corner lots. Across 4th Street, bars are seen on windows and no pedestrian activity is visible. As was seen in Camden Square, the development on Elizabeth Avenue successfully shields the decline. Upon

my visit, the same situation arose where I witnessed active diners and then a short distance away a homeless man drinking in an abandoned lot.

| East Park | Acreage | Mobility | SF, owner-occupied | Home Value | Household Income |
|----------------------------|---------|----------|--------------------|------------|------------------|
| Average | 0.64 | 23.03% | 78.13% | \$338,854 | \$58,930 |
| Standard Deviations | * | 0.10 | -0.45 | 1.21 | 0.13 |

Table 20: Average area characteristics of the East Park brownfield redevelopments.

Statistically, the East Park area sees a substantial disparity between household income and home values despite income being slightly above average in terms of household income. In this area single-family owner occupancy rates are higher but the percentage of people who moved within the past year is lower counter-intuitively.

At East Park, being another inner-suburban area of redevelopment, the market is made mostly of metropolis and solo acts, similar to Camden Square. The difference is the proportion of wealthier segments (metro renters and urban chic) compared to others, notably city strivers. The area around the site is in better physical condition so this is not surprising. This is reinforced by the higher income and home value in relation to the Camden Square area. The tapestry data for a quarter-mile area was aggregated as well for both East Park and Camden Square, revealing that both quarter-mile areas are predominately lower-income metropolis and, in the case of East Park, college students. When the buffer is extended to a half-mile then wealthier segments become notable.

| Tapestry Segmentation Group | Tapestry Segment | Percent |
|--------------------------------|------------------|---------|
| Solo Acts | Metro Renters | 66.3% |
| Metropolis | City Strivers | 21.7% |
| Scholars & Patriots | College Towns | 6.4% |
| Upscale Avenues | Urban Chic | 5.6% |

Table 21: Tapestry segments represented a half-mile from the center of the East Park area.



Figure 20: Restaurant that is a redeveloped brownfield on Elizabeth Avenue (left). Redeveloped brownfield adjacent to non-redeveloped brownfield on 4th Street (right).

4.6.3: Summit Avenue

Near the intersection of West Morehead Street and Summit Avenue are two redevelopments that developed brownfield sites with soil and groundwater contamination into usable commercial sites. South of Morehead Street is a former chemical storage facility that has been renovated into a night club; north of Morehead Street is auto repair site that was cleaned, renovated, and included an added commercial development. West Morehead Street is not a commercial anchor comparable to South Boulevard nor does the area have a hospital or act as a neighborhood center as with East Park. However, the street does have good, immediate access

to downtown and the football stadium area. Additionally, the night club site has good visibility when exiting I-77 and is easily accessed when doing so. Northbound on West Morehead you are lead to Freedom Drive which quickly transitions to an area in decline as the distance from downtown increases. There is one additional redevelopment site; however, it is another that is more of a rehabilitation project into its previous use as a site for tanker truck storage and maintenance. Freedom Drive is covered in the discussion of areas absent redevelopments.

| Summit Avenue | Acreage | Mobility | SF, %Owner-Occupied | Home Value | Household Income |
|---------------------|---------|----------|---------------------|------------|------------------|
| Average | 1.57 | 31.82% | 50.03% | \$208,954 | \$35,069 |
| Standard Deviations | * | 0.85 | -2.23 | 0.19 | -0.71 |

Table 22: Average area characteristics of the redevelopments on Summit Avenue.

Income along Summit Avenue and in the West Morehead Street area is substantively lower than in the area around Camden Square or East Park as seen in table 22. Despite this, home values are more than \$30,000 above the county median. Not surprisingly, there are also a notably higher mobility rates and lower single-family owner occupancy rates. However, it was found that when single-family owner-occupancy rate is estimated at the parcel-level the Summit Avenue area is closer to 70% or approximately one (1) standard deviation below the county average. This goes with the redevelopments being in a pocket of positive development near a corridor of decline (Freedom Drive). However, this situation is unique as the Summit Avenue properties are adjacent to single-family homes and that is not the case for most of the redevelopments.



Figure 21: Club 935 brownfield redevelopment on Summit Avenue (left). Streetscaping along West Morehead Street (right).

The market segmentation in the area around these two redevelopments is the wealthier metropolis group, metropolitans, and family foundations, a segment of traditional living who live a middle-class lifestyle. These are unexpected market segments given the high rental-rate with single-family homes but expected given the condition of the area. These groups are noted as being found in neighborhoods of slow change. This fits well with the observation that the two brownfields in this area were renovated as much as redeveloped. The night club is the same building as was formerly used for industrial purposes and the automobile site is mostly still used for automobile purposes. The third redevelopment nearby that is off Freedom Drive is also observed as being remediated and renovated for the same use as it previously was.

| Tapestry Segmentation Group | Tapestry Segment | Percent |
|------------------------------------|-------------------------|----------------|
| Traditional Living | Family Foundations | 63.6% |
| Metropolis | Metropolitans | 36.4% |

Table 23: Tapestry segments represented a half-mile from the intersection of West Morehead and Summit Avenue.

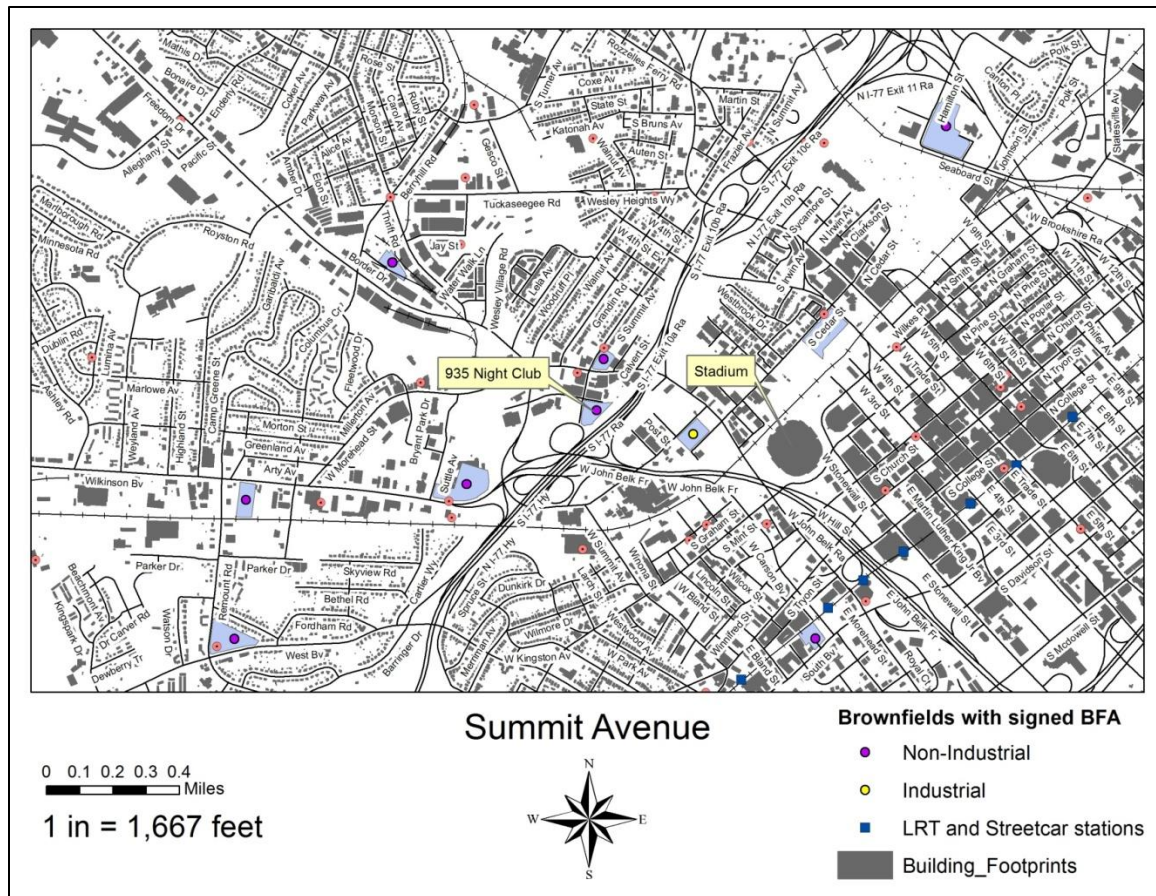


Figure 22: Map of Summit Avenue area.

4.6.4: Westinghouse Boulevard

Westinghouse Boulevard is the arterial road for two industrial redevelopments. The area is exceptionally clean for an industrial zone and features wide roadways conducive to large transport vehicles. Residential uses are practically nonexistent in the immediate area and there is some minor commercial such as a bank and gas station. Even though the area is industrial-oriented there are sidewalks and a pedestrian would be able to successfully navigate the area. The road network is designed for immediate access to I-485.

| Westinghouse Boulevard | Acreage | Mobility | SF, %Owner-Occupied | Home Value | Household Income |
|-------------------------------|----------------|-----------------|----------------------------|-------------------|-------------------------|
| Average | 9.92 | 44.21% | 97.25% | \$183,596 | \$55,759 |
| Standard Deviations | * | 1.90 | 0.77 | -0.01 | 0.02 |

Table 24: Average area characteristics of the redeveloped industrial sites off Westinghouse Boulevard.

The statistical characteristics of the area surrounding the two industrial redevelopments near Westinghouse Boulevard show income and home value near equal in terms of standard deviation. These properties are in an area of comparably high incomes and owner-occupancy rates. However, the population is still considerably more mobile than the county average. This is likely related to the suburban nature of the area as well as a workforce population in apartments or multiunit housing facilities.

Despite being located in a tract dominated by family portrait market segments, the closest housing units to the Westinghouse Boulevard redevelopments are solo acts. The young and restless segment is most notable for being in areas under constant change and movement, potentially as a result of temporary or new industry workers locating closer to work early-on. Regardless, this tapestry segment and the lack thereof in terms of immediate households highlights how exurban and suburban industrial redevelopments are isolated from substantive and established residential development.

| Tapestry Segmentation Group | Tapestry Segment | Percent |
|------------------------------------|-------------------------|----------------|
| Solo Acts | 39. Young and Restless | 100.0% |

Table 25: Tapestry segment represented a half-mile from Westinghouse.



Figure 23: Westinghouse Boulevard (left). Redeveloped industrial site on Westinghouse Boulevard (right).

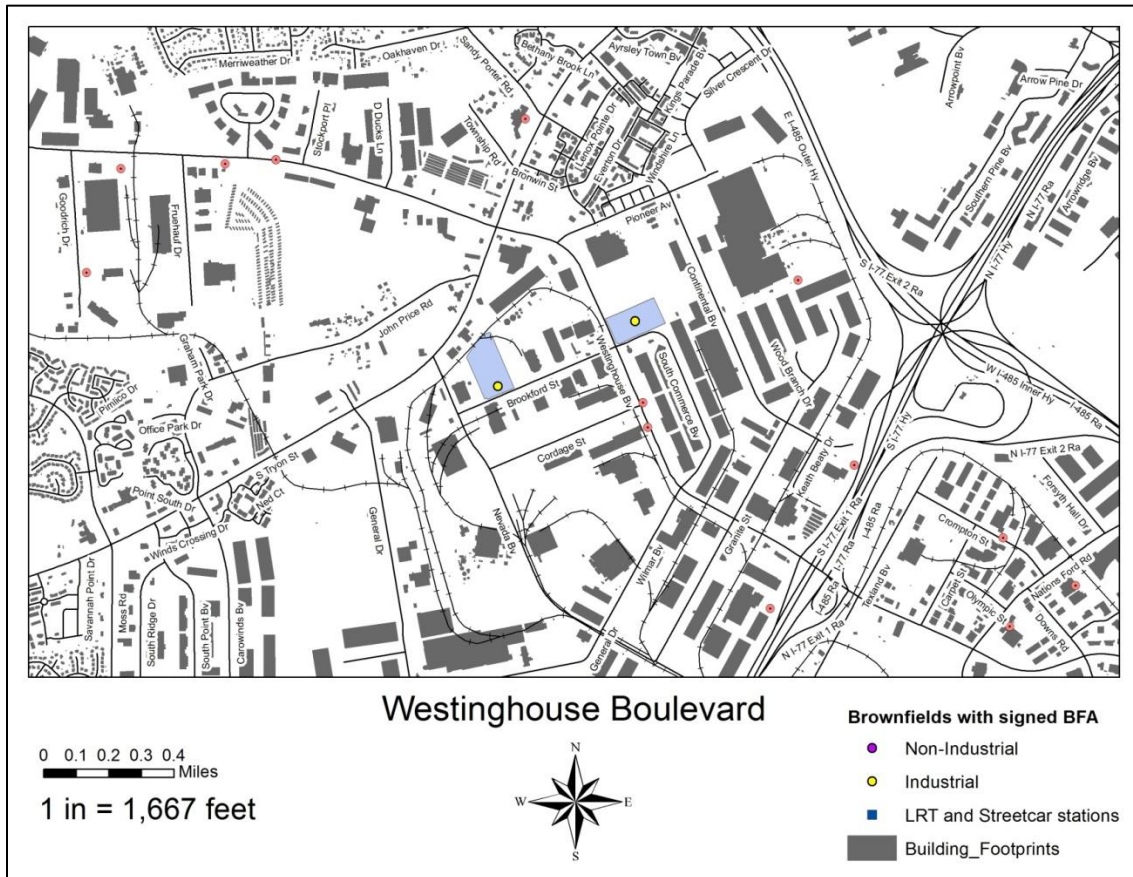


Figure 24: Map of Westinghouse Boulevard area.

4.6.5: Other Areas

Two corridors were driven during the process of the site visits. First was Freedom Drive northwest of downtown Charlotte and second was Graham Street northeast of downtown Charlotte. Freedom Drive is an area where few brownfield redevelopments have occurred and those that have are concentrated near downtown, however, several inactive hazardous waste sites are evident meaning the potential for unclassified brownfields. Graham Street is an area with a recent cleanup agreement signed but where redevelopment has yet to occur. The Charlotte-Mecklenburg planning website describes Graham Street as a rising spot for brownfield redevelopments due to planned expansion of the light rail system. One speculative property is the Hutchinson Shopping Center which has been purchased with eventual plans to be redeveloped as commercial and residential. At its current location this seems unlikely but southbound on Graham Street as you cross under Brookshire Freeway you immediately see high quality, high density residential development thus it is clear development is moving that way.

North Freedom Drive near I-85 is an area with numerous greyfields, possibly brownfields though their appearance does not necessarily suggest contamination. As you continue there is an increase in alternative financial institutions and industrial properties. Several of these properties clearly lay abandoned with ample signs of break-ins and vandalism and many are clear brownfield sites. Based on the signage and other indicators of past usage these sites are likely contaminated and are thus brownfields by the EPA definition. Additionally, a map of IHW sites and delinquent properties of industrial or commercial usage shows that in the collector streets around Freedom Drive there is the likelihood of significant contamination and some underutilization.

| Hutchinson Shopping Center | Acreage | Mobility | SF, owner-occupied | Home Value | Household Income |
|-----------------------------------|----------------|-----------------|---------------------------|-------------------|-------------------------|
| Average | 5.477 | 41.58% | 54.19% | \$89,007 | \$20,022 |
| Standard Deviations | * | 1.67 | -1.97 | -0.76 | -1.23 |

Table 26: Area characteristics a half-mile from Hutchinson Shopping Center.

While the site is speculative, looking at the statistical surrounding of Hutchinson Shopping Center shows an area with numerous brownfields unrealized as well as several industrial redevelopments on the fringe. Additionally table 26 shows Hutchinson Shopping Center has similar trends to other areas. Both income and home value are significantly lower than at other brownfield redevelopments, however, there remains a difference between the two. Additionally, the detached-single-family owner occupancy rate is significantly lower than most other brownfield redevelopments. The lower income and owner-occupancy shows the area as in a greater state of decline than those that have seen brownfields redevelop.

Averaging the statistics for five (5) inactive hazardous waste sites along Freedom Drive we see that Graham Street and Freedom Drive are statistically similar with the exception of mobility, in which Graham Street is significantly more mobile than Freedom Drive. Freedom Drive is an area in physical and economic decline where residents don't move and the neighborhood shows little propensity to change.

| Freedom Drive | Mobility | SF, owner-occupied | Home Value | Household Income |
|----------------------------|-----------------|---------------------------|-------------------|-------------------------|
| Average | 30.07% | 53.14% | \$85,894 | \$23,696 |
| Standard Deviations | 0.70 | -2.03 | -0.78 | -1.10 |

Table 27: Average area characteristics of inactive hazardous waste sites near Freedom Drive and I-85.

Brookshire Freeway sees similar statistical characteristics for its northern section leading to I-85 as well. The notable statistical difference between Graham Street and Freedom Drive from the others sites visited is the lower home value. This difference however, does not accurately represent the physically noted lack of connection to other areas of significance or the witnessed physical decline in terms of structures of all uses.

Tapestry segmentation for the Hutchinson Shopping Center reveals substantive poverty. The two segments represented are two of the four lowest income segments. They are categorized by higher levels of public assistance, high unemployment rates, and relative social isolation (the internet is the worst way to communicate with these segments). The disparity in market segments between this site and other redevelopments reinforces the notion that Hutchinson is currently a speculative purchase for future development along Graham Street.

| Tapestry Group | Tapestry Segment | Percent |
|---------------------------|-------------------------|----------------|
| Metropolis | Modest Income Homes | 81.2% |
| Traditional Living | City Commons | 18.8% |

Table 28: Tapestry segments represented a half-mile from the Hutchinson Shopping Center.

4.6.6: Wake County Tapestry Sample

True site visits were not able to be incorporated into the analysis in Wake County due to budget and time constraints. However, Bing Maps aerials were used to confirm the connection of brownfield developments to positive development corridors. Additionally, representative sites (map 16) were selected to review tapestry data for the half-mile surrounding area around several dispersed sites. The sites were selected to sample different types of redevelopments in terms of location and end uses.

| Tapestry Group | Tapestry Segment | Percent |
|--------------------------------|-------------------------|----------------|
| Metropolis | Metropolitans | 54.0% |
| Solo Acts | Metro Renters | 19.3% |
| Scholars & Patriots | College Towns | 18.2% |
| Solo Acts | Old and Newcomers | 8.4% |

Table 29: Pilot Mills

The Pilot Mills site is centrally located and as such is mostly wealthier urban residents. Pilot Mills is a turn-of-the-century textile mill that is being preserved and renovated into an office building and restricted from residential use. The feasibility of reusing the structure is similar, albeit in a different way, to the sites on Summit Avenue where the sites were renovations as much as redevelopments and metropolitans were the same dominant tapestry segment in this area. College Towns is a segment that is a product of Raleigh being a part of North Carolina's Research Triangle. These are a mix of current college students and young university researchers who have lower incomes but live a disproportionately high quality of life and are highly technical.

| Tapestry Group | Tapestry Segment | Percent |
|-----------------------|-------------------------|----------------|
| Solo Acts | Old and Newcomers | 50.6% |
| Upscale Avenue | In Style | 41.4% |
| High Hopes | Aspiring Young Families | 8.0% |

Table 30: Costco

The area surrounding the Costco redevelopment is relatively isolated from residential development as there are no households within a quarter-mile. While being a commercial redevelopment, the site is similar to the industrial redevelopments near Westinghouse Boulevard in Mecklenburg County. It is characterized by a mix of higher income residents and

neighborhoods characterized by constant change. The sampled industrial redevelopment, the Triangle Drive property, is a neighborhood of suburban, mobile, young professionals.

| Tapestry Group | Tapestry Segment | Percent |
|-----------------------|----------------------------|----------------|
| Upscale Avenue | Enterprising Professionals | 100.0% |

Table 31: Triangle Drive

| Tapestry Group | Tapestry Segment | Percent |
|------------------------|-------------------------|----------------|
| Family Portrait | Up and Coming Families | 100.0% |

Table 32: Cal-Tone Paints

Cal-Tone Paints is a larger site that is planned for commercial, office, and industrial uses. Through Bing Maps the site is observed to be located on a major arterial road some distance from lower quality mobile housing and middle-class suburban subdivision housing. Up and coming families is a segment of more affluent, suburban families, simply put, who have achieved the American dream. There isn't a true match for this in the Mecklenburg site visits; for comparison the suburban site tapestry of Anchor Mill in Huntersville, Mecklenburg, NC, is provided as well.

| Tapestry Group | Tapestry Segment | Percent |
|---------------------------|-------------------------|----------------|
| Traditional Living | Main Street, USA | 63.1% |
| Upscale Avenue | Cozy and Comfortable | 25.6% |
| Family Portrait | Up and Coming Families | 11.4% |

Table 33: Anchor Mill

Main Street, USA is a segment that is slightly less affluent than up and coming families but also is the traditional suburban, "American dream," type of household. Thus the general

finding in suburban areas is that there has to be an element of affluence for non-industrial redevelopments to occur. Industrial redevelopments are likely to occur in areas separate from residential. However, there is also the issue that in these areas there is not the extensive history of brownfields that there is in the inner suburbs or in central cities.

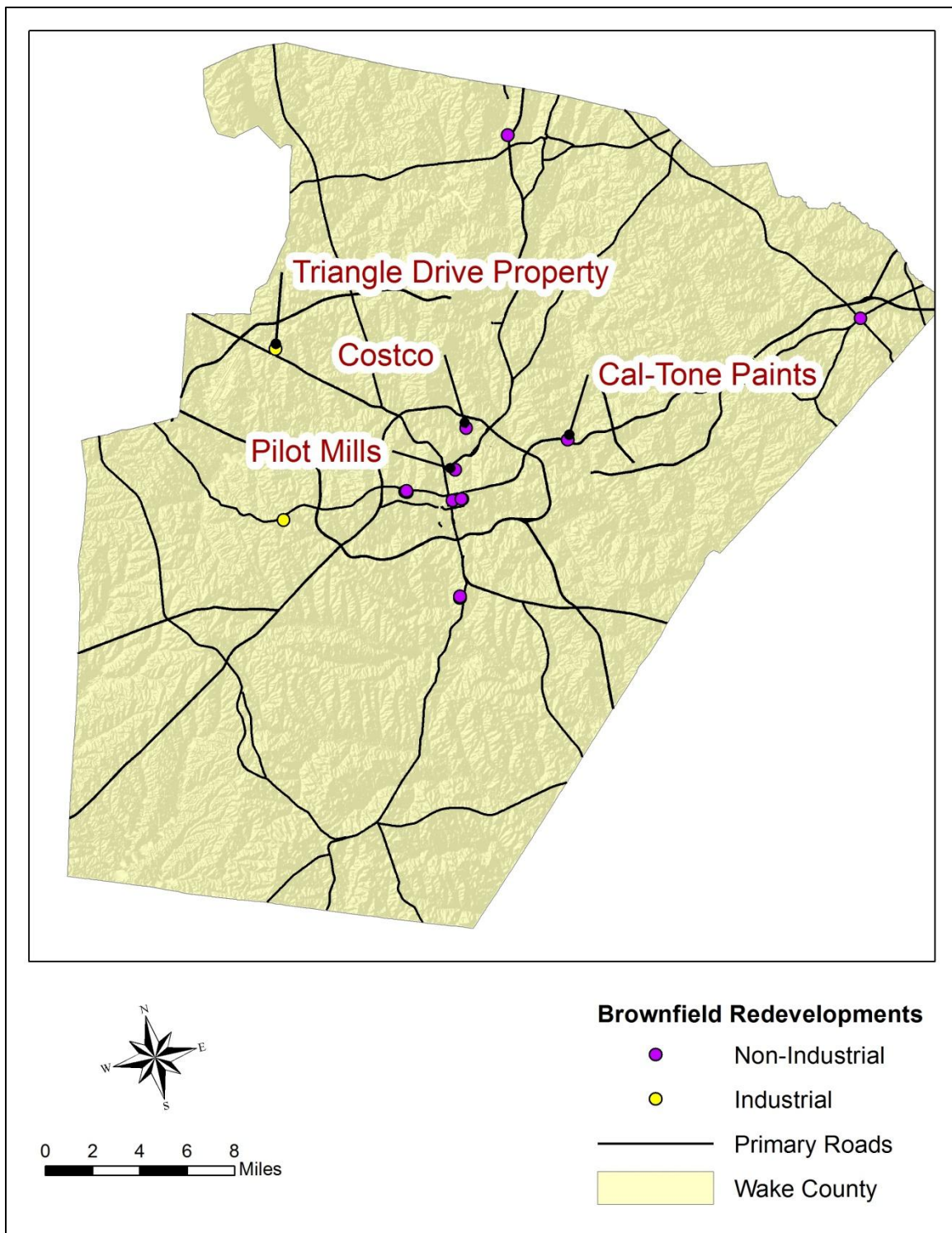


Figure 25: Map of select Wake County redevelopments.

CHAPTER 5: FINDINGS

This analysis reveals several key trends and shared attributes of brownfield redevelopments that are consistent for both Mecklenburg and Wake Counties. A brief discussion of these findings tie together parts of the analysis before moving into a discussion of how these findings fit with current brownfield redevelopment literature as well as potential policy implications.

- A. Areas surrounding non-industrial brownfield redevelopments are those where home values are greater relative to household income.*

A comparison of the inactive hazardous waste sites and brownfield redevelopments reveals that redevelopments occur in areas where income is lower than would be expected given the area home values. Table 2 shows the expected positive correlation between income and home values in the area around brownfields. The difference, in varying magnitudes, is evident in Wake and Mecklenburg Counties, but less so for industrial redevelopments in both. Additionally, a comparison with inactive hazardous waste sites revealed that a mismatch was less evident with non-redeveloped sites. When the overlap between inactive hazardous waste sites and areas surrounding redeveloped brownfields was controlled for, the difference between income and home values in terms of standard deviations was almost zero (tables 10 and 11). The correlation value between the difference in income and home value standard deviations and the ratio of home value to household income is -0.96, showing a strong negative correlation. The greater number of standard deviations home values in relation to the county median are above household income standard deviations the lower the percentage household income is of home values. Thus the divide is evidence of housing becoming unaffordable in the areas surrounding brownfield redevelopments. This relationship holds true for some industrial

and most non-industrial properties, but recall that industrial properties had a significantly smaller difference between home values and household incomes. Overall, it is observed that the trends for non-industrial brownfield redevelopments is to have home values that are average for the greater area (in this study that is defined as the county) matched with incomes that are below average when compared with the greater area.

B. Brownfield redevelopments occur in areas of greater physical mobility (resident transiency) and lower rates of detached-single-family owner-occupancy rates.

Consistently the redeveloped brownfields occurred in areas with below average percentages of detached-single-family homes being owner-occupied. Both in Wake and Mecklenburg the area surrounding redevelopments was on average more than one (1) standard deviation below the county median and only six (6) of 87 redevelopments were a positive value. Correlated to this is percentage of households who have moved within the past year, with more people moving as fewer owners occupy detached-single-family homes. In addition to this correlation, there is a trend seen with household income and with acreage (table 34).

| SF, %Owner-Occupied | Acreage | Mobility | Home Value | HH Income | Count |
|---------------------------|---------|----------|------------|-----------|-------|
| Less than -2 deviations | 5.07 | 1.49 | 0.21 | -0.61 | 17 |
| 0 to -2 deviations | 9.98 | 0.59 | 0.00 | -0.49 | 68 |
| Greater than 0 deviations | 15.67 | 0.46 | 0.18 | 0.22 | 6 |

Table 34: Area characteristics of redevelopments sorted by a grouping of area standard deviations of detached-single-family owner-occupancy rates.

The decline in acreage correlating with a decline in owner-occupancy rates relative to the county is counterintuitive as it would seem a larger site would be needed in order for the development to buffer against surrounding neighborhood decline. Site visits suggest that in areas of less neighborhood decline there is a better pre-existing separation of industrial and

non-industrial uses. Thus larger, abandoned industrial sites are more common as is seen with the Westinghouse sites. Additionally, the areas of above average owner-occupancy are only barely so and are located in suburban areas with lower density development. While highly dispersed, there is also a correlative decline in income to home value relationship as owner-occupancy declines. This would be expected as higher rates of renter occupancy imply lower incomes and would then be expected to result in a less favorable ratio between income and home value. Table 34 shows that household income consistently rises with owner-occupancy; however, the median home value is uncorrelated.

In multiple sites, overall mobility, as measured by percent of residents whom moved within the past year, was found to be higher than the respective county levels with some exception. First, the level of mobility is correlated to detached-single-family owner-occupancy rates thus large industrial sites such as those found on Westinghouse Boulevard are in areas where residents move at a rate near the county average. The suburban industrial sites in Wake County are also statistically significant in their difference with the non-industrial redevelopments. The sites on Summit Avenue and in East Park are a second caveat to mobility trend. Both areas have a lower rate of residents moving within the past year than would be expected when compared to their single-family owner-occupancy rates, relative to the county. However, both of these areas are noted as seeing redevelopments that are more renovations than projects that contrasted with neighborhood character. Similarly, the difference seen between the speculative site of Hutchinson Shopping Center and the blighted area of Freedom Drive is the level of resident mobility (tables 26 and 27). Thus resident mobility is an area characteristic of redevelopment projects that contrast with the character of the neighborhood. For example, Camden Square is resulting in an increase of residents that are representative of

solo market segments in a metropolis tract, whereas Summit Avenue and East Park are seeing minimal neighborhood change.

C. Industrial redevelopments occur in areas of the greatest and the least decline.

Industrial sites are unique in that they redevelop in areas of the least decline and the most decline. This is evident from the difference in area characteristics of industrial redevelopments in Mecklenburg and Wake Counties and the spread of industrial sites in tracts with both the upper avenue as well as lower income tapestry segment groups. For further understanding of how they fit into redevelopments they are broken down for Mecklenburg County in table 35 by inner and outer based on proximity to downtown Charlotte and observed densities. Recall that Wake County industrial sites are suburban in nature and are light-industrial uses such as a warehouse. Mecklenburg sites follow several traditional trends such as declining income and home-ownership rates in the urban areas. The inner industrial sites are similar to the Hutchinson Shopping Center in that they have below average income and below average home values. They also have an owner-occupancy rate slightly below average for brownfield redevelopments overall; given this, they have a mobility rate that is considerably lower than would be expected. This suggests inner-suburban and urban industrial redevelopments are occurring in areas of greater economic decline, potentially greater physical dilapidation, and in neighborhoods that see less physical movement of residents and thus are less likely to see change. They are also larger in size, but this may be linked to property values in the area. A developer may need additional acreage in order to see a sufficient return on investment as they are unable to increase the price-per-acre comparable to suburban or exurban areas. In terms of site visits, this is in line with the differences observed by location. The outer industrial redevelopments were in well-maintained areas with some minor commercial whereas the

corridors with the inner industrial redevelopments were typically very rundown with the main commercial element being alternative financial institutions or thrift shops.

| Industrial Sites | Acreage | Mobility | Home Value | SF, %Owner-Occupied | Household Income** | Count |
|------------------|---------|----------|------------|---------------------|--------------------|-------|
| Total | 13.00 | 0.65 | -0.45 | -1.06 | -0.68 | 13 |
| Inner | 15.12 | 0.26 | -0.54 | -1.48 | -0.94 | 7 |
| Outer | 10.54 | 1.10 | -0.36 | -0.57 | -0.39 | 6 |

Table 35: Comparison of industrial sites based on being inside or outside the inner beltway of Charlotte, NC.

** Significant at the .05 level

D. Neighborhood characteristics surrounding some commercial and residential brownfield redevelopments may not see significant change but consumer and market characteristics will.

The site visits and tapestry data both point to a trend in areas around brownfield neighborhoods that suggest the neighborhood will change in some ways while staying the same in others. Contrary to some of the literature, brownfield redevelopments are not singularly catalytic for area revitalization. Camden Square is an area that began redeveloping in 1998 and has incrementally seen improvements over the years, but there are still numerous existing brownfields in the immediate area and the positive trends drop off dramatically after crossing the arterial roads South Tryon Street or West Boulevard. East Park has seen several brownfields redevelop, but again there are several sites nearby that show no signs of redeveloping, and across the street positive development seems to decline. A Bing Maps view of the Cal-Tone Paints site in Raleigh shows a new subdivision adjacent to the north and across the arterial, New Bern Ave., a transition to mobile homes and dirtier industrial sites is visible. However, the preceding statistics and personal observations show that despite redevelopment of brownfield

sites of varying sizes, area change has been minimal in terms of single-family owner-occupancy rates and household income, but has changed in terms of overall lifestyle area quality.

Tapestry assists in explaining some of this as it shows the lifestyle of the surrounding neighborhood as well as the tracts. Many of the new brownfield redevelopment areas are populated by younger residents who are not established yet. These residents are still likely to rent but also not have children and be unwedded. Being early in their career, single, and living alone, household incomes are less likely to appear above the county median; however, without children they have a greater willingness to pay higher rents. Additionally, both wealthier metropolis residents and solo acts utilize commercial establishments, such as gyms and restaurants, with greater frequency, thereby increasing demand for these services in the area. This all leads to upward pressure on land prices for commercial and mixed-use development which is revealed through rising land and home values. This shows a possible explanation for these areas and the blend of urban poor and young professional that both market segmentation and site visits suggest exists.

Through these four findings, insight is gained as to how brownfield redevelopments fit with the neighborhoods and the urban fabric. Much of whether a brownfield redevelops depends on the condition of the surrounding area before the redevelopment, as the evidence does not suggest brownfields can ignite widespread redevelopment momentum. In areas of previous decline, non-industrial brownfield redevelopments occur in transition areas between areas of notable decline and areas of non-decline. There is a need for previous positive development trends to exist for these redevelopments to be successful. The change seen in these areas is mostly one in the consumer lifestyle of the residents as they are likely to remain mobile, rental-dominated neighborhoods. Given the social characteristics of the residents in

these areas, issues such as low-quality schools, home ownership, and household income levels may be slower to evolve. In areas of pre-existing decline with no area of positive development trends nearby, brownfields are likely to remain undercounted; brownfield redevelopments are industrial or office-commercial in use, or uses where customer exposure is less common and residential use is absent. Part of this is the lower cleanup costs associated with industrial redevelopments due to different standards. The difference in sizes of industrial redevelopments based on distance to downtown Charlotte in Mecklenburg County suggests that, in addition to needing lower cleanup costs, these redevelopments need larger acreages for greater returns.

Summit Avenue is an area that, from a statistical standpoint, is in decline; however the tapestry shows residents in the immediate area around the two redevelopments are wealthier in relation to the other tract residents. Mobility rates are lower than would be expected given the lack of owner-occupancy implying a low propensity to change in terms of neighborhood characteristics. The statistics suggest, and are reinforced by the tapestry segmentation, that such an area sees minimal change and is home to urban residents ranging from low to middle class. These redevelopments, similar to East Park where mobility is also low, are ones that don't provide much change in terms of neighborhood makeup or economics but that keep the buildings in use. They typically need to have the better locations in order to see redevelopment, hence the remaining brownfields in East Park existing where commercial activity is lower. Ultimately, non-industrial redevelopments occur in areas that are justifiable by the property values relation to the surrounding area, be it a site in a dilapidated area that sees an increase due to adjacency to positive development trends or at a prime economic location for the neighborhood.

Suburban brownfield sites are less frequent due to a history that has not resulted in as many brownfields and thus more difficult to classify. However, the observed suburban industrial redevelopments in Wake and Mecklenburg Counties are found in areas at or near the county median in terms of home values and household incomes. They are also observed to be separated from residential uses and have immediate access to primary roads.

CHAPTER 6: IMPLICATIONS

The findings from the analysis are useful in regards to prioritizing and selecting types of public funding and community effort surrounding brownfield redevelopments. The analysis highlights how different areas have seen different types of brownfield redevelopments emerge in Mecklenburg and Wake Counties. Understanding when and the types of brownfields that may emerge in given areas is important both to setting realistic expectations as to redevelopment options, being aware as to what specific barriers may become involved, as well as what action may help potential redevelopment sites overcome these barriers. When expectations and awareness are more appropriate, redevelopment efforts become more targeted and efficient. Additionally, studying neighborhood characteristics may help identify area weaknesses that need to be addressed prior to brownfield redevelopment. Consequently, for more blighted areas this may involve the hardship of accepting that new, growth-generating redevelopment is infeasible and that community efforts are best expended on less headlining ventures.

6.1: Integration with American Planning Association Manual

One of the goals of this research was to expand on the redevelopment process from the



Figure 26: APA community redevelopment process for brownfields.

APA manual, *Reuse: Creating community-based brownfield redevelopment strategies*. The manual suggests a six step process for communities to turn brownfields from liabilities

to opportunities; this research relates to steps one (1) and four (4) or “develop a community vision” and “determine reuse options” respectively. Currently the procedures outlined for each step are fairly open-ended bringing awareness of the need for individual communities to address a wide array of issues prior to implementing a redevelopment plan. A key recommendation is for the outlined visioning process to add an additional question for consideration. Currently the four questions are:

- Where are we now?
- Where are we going?
- Where do we want to be?
- How do we get there?

A fifth question needing to be addressed is: what is the relationship of the target community with surrounding communities? The emphasis of the manual is on identifying current conditions within the community both demographically and economically. Added to this should be a caveat for a community to consider other nearby neighborhoods, and whether they have a greater or lesser propensity to attract certain types of developments when compared to these nearby areas. The research finds that areas of different economic and mobility states are able to accommodate different styles of redevelopments, for example commercial and residential revitalization projects at Camden Square compared to commercial renovation projects on Summit Avenue; this finding can help the visioning process produce a vision more in line with reuse options that emerge in step four.

Step four is essentially a basic outline for a community to do a simple strength, weakness, opportunities, and threats analysis:

- Define allowed uses;
- Determine market conditions;
- Assess the community’s needs; and
- Analyze the options and determine an appropriate end use.

The final step involves exploring implementation challenges and potential barriers to redevelopment. Understanding the neighborhood conditions assists in understanding what barriers exist in terms of neighborhood condition. Table 36 shows the more probable barriers areas will face given the nature of the immediate area they are in.

| Type of Area | Hold outs | Resistance to Change (NIMBY) | Economic Condition | Prisoners Dilemma | Upside-Down Sites | Unknown Future |
|------------------------------|-----------|------------------------------|--------------------|-------------------|-------------------|----------------|
| Blight w/adjacent non-blight | X | X | | X | | |
| Blight | | C | X | X | X | |
| Suburban (low-density) | | C | X | | X | |
| Good economic health | X | C | | X | | |
| Speculative investment | | X | | X | X | X |

Table 36: Neighborhood types and corresponding barriers to redevelopment that are of greatest potential.

Note that any of these barriers could exist to redevelopment projects in any of the corresponding areas.

"X" - significant vulnerability to a barrier

"C" - a significant vulnerability depending on proposed redevelopment projects

Blighted areas that are improving or adjacent to non-blighted areas, similar to Camden Square and Summit Avenue, appear at higher risk to encounter holdouts, resistance to change, and prisoner's dilemma situations. Intermixed with Camden Square area redevelopments are sites that are clear brownfields and showed no sign or written record of moving towards redevelopment. These sites are older and may have questions of ownership from their history; additionally, given the direction of development and increasing densities, owners may also be holdouts who believe the land will continue to increase in value without improvement. Also near Camden Square, particularly the sites closer to South Tryon Street, is a prisoner's dilemma

situation in which sites were redeveloped but surrounding sites did not make additional investment. This has clearly lowered the economic activity the redeveloped sites enjoy and is likely keeping the property values lower than what they could be.

Summit Avenue sites redeveloped given the economic health of the area; however, given the mobility rates compared to the low owner-occupancy rates, as well as the tapestry data reported, the area is less subject to change. This is also shown by the nature of the redevelopments that occurred, where Summit Avenue has not attracted new or diverse market segments as Camden Square has. A lack of diversity or change in the area market segments reduces the demand for a wider variety of businesses and reduces the amount of redevelopment that occurs overall. While Summit Avenue saw redevelopment, there was an abrupt decline in redeveloped sites and corresponding increase in abandoned buildings traveling north on West Morehead Street away from Summit Avenue. This is contrasted with the transitioning market tapestry and neighborhood demographics seen around Camden Square.

Blighted areas such as Freedom Drive are limited by the general economic condition. Lower incomes lead to reduced consumer spending leading to less demand for commercial real estate. Additionally, lower incomes also result in lower home and property values. The lower value of the land means there is a greater chance the cost of the cleanup is greater than the property and it is upside-down. The probability of sites being upside-down creates an inevitable prisoner's dilemma, as it is unlikely surrounding property owners will make investments in their property due to a greater risk that brownfield properties will not invest in physical improvements. Blighted areas, along with suburban areas and economically healthy neighborhoods, are marked "C" to signify a conditional vulnerability to resistance to change. These areas are unlikely to face resistance to redevelopment because residents want the

properties utilized, but they are vulnerable to resistance to redevelopments that change the character of the neighborhood even if it is the only way the site will redevelop.

Low-density suburban locations run similar risks but for different reasons. Given their low-density, land is cheaper and the cost of site-cleanup may make the site feasible compared to a greenfield. However, prisoner's dilemma is less of an issue in areas of low density as the spacing is greater between buildings and uses thus they have less of an influence on neighboring sites. Similarly, these sites are the least vulnerable to the barrier of having to assemble parcels as they are larger parcels not needing assembly. Whether these locations redevelop is more closely related to their proximity to needed infrastructure, as is the case with the redevelopments on Westinghouse Boulevard and the two suburban industrial redevelopments in Wake County.

Areas of good economic health, such as East Park, are subject to potential holdouts and prisoner's dilemma situations, as was seen with the abandoned dry cleaners on 4th street. As was also seen with East Park, the pre-existing surrounding area already featured enough economic vitality in order to support the new commercial activity the redevelopments produced. The remaining sites will likely redevelop when density or growth increases demand for land in the area.

Speculative investment areas such as the Hutchinson Shopping Center are currently unable to support redevelopment. Properties here are purchased in preparation for future development making these areas exceptionally vulnerable with regards to the unknown future. As they are also blighted areas, many sites are likely to be upside-down; the economic condition of the area is left unchecked as a barrier since properties as speculative purchases infer there is an understanding of current economic conditions. These areas are, however, susceptible to

resistance to change. Speculative activity implies that when redevelopment occurs it will result in new market segments and changes in neighborhood characteristics.

6.2: Keys to Site Success

Brownfields and general infill development may face exceptional barriers. In addition to locational advantages, such as unique transportation advantages, there are other characteristics that can help sites exceed. Many sites are only one (1) or two (2) acres but have other characteristics that assisted in making their redevelopment feasible. Table 37 shows the same type of areas as before and characteristics that appear to have assisted in making redevelopments successful based on theory and observation. Absent from the table is access but all sites benefited from freight, streetscape, or transit improvements.

| Type of Area | Example | Size | Economic Vitality | Affordability | Flexibility (Mobility) |
|-------------------------------------|----------------------------|------|-------------------|---------------|------------------------|
| Blight w/adjacent non-blight | Camden Square | | X | | X |
| Blight | Freedom Drive | X | | X | |
| Suburban (low-density) | Westinghouse Boulevard | X | | X | |
| Good economic health | East Park | | X | X | |
| Speculative investment | Hutchinson Shopping Center | | | X | X |

Table 37: Keys to success by neighborhood type.

Areas such as Camden Square, where the immediate area is a blighted area but is connected to a commercially active area, need flexibility in terms of their consumer makeup. A strong contrast of residents is found through observation and tapestry segmentation. They are a

mix of lower-income, urban residents but also young professionals on the rise. While there are similarities in terms of these segments required neighborhood structure, they each have their own needs in terms of services and unique lifestyles. However, the two are both significant to the neighborhood. Summit Avenue is similar but without comparable resident mobility. This area saw redevelopments as a result of access and economic vitality, it did not feature a contrasting mix of residents as with Camden Square. Similarly, Summit Avenue did not have a comparable contrast in terms of housing quality or type. Thus what flexibility and mobility as a site trait for successful redevelopment also means is the community needs to be aware of likely displacement of residents or a needed increase in housing stock for current and new residents. In redevelopment planning situations this issue may force a choice, developing a long term relocation strategy or not pursuing redevelopment that is of the highest and best use. As statistics show, Camden Square is seeing a significant shift in demographic and resident makeup. The findings suggest that were it not for physical mobility and openness to change the area would likely not experience the level of redevelopment that has occurred.

Sites in blighted areas and suburban locations are likelier to need substantial acreage in order to be successful. From a theoretical standpoint, this is partly due to the lower property values as a developer will need more acreage in order to get a return on investment after paying cleanup costs. From an observational standpoint, size is partly a factor of the end uses, which are mostly industrial or commercial uses such as offices or storage facilities. The Wake County industrial redevelopments were both suburban in location and small in size, thus it is clearly not an ultimate necessity. As with any situation, if the price is right then it can work. Affordability is a critical factor in each of these locations, as the lower property values mean cleanup costs

could easily be more than the value of the site, thus a reasonable price is needed to prevent the site from being one that is upside-down.

Areas of good economic health, such as East Park, are places where redevelopment will naturally occur as long as investments are made to maintain and increase economic vitality. The East Park redevelopments seemed successful mostly as a result of creating Elizabeth Avenue into a pedestrian-friendly, neighborhood-center type location. The economic vitality is what will drive the redevelopments as property values tend to already be at or above the county average limiting the residents that could afford to relocate. Additionally, these sites are also at risk of affordability issues if property owners fail to recognize or accept reasonable sale prices that account for the additional risk and cost of brownfield site assessment and potential contamination. Areas such as Camden Square are also driven by economic vitality, but more in making access geared toward adjacent economic vitality as opposed to blight. Affordability is not identified as it is in economically healthy areas, the reason being that in transitional blighted areas property values, in theory, are lower and can be raised with improvements that build on the adjacent economic health to offset cleanup costs. However, as was previously noted, these sites are susceptible to holdouts who overestimate the speculative value of such brownfield sites.

6.3: Implications for Local Government

Current local government attention to brownfields is varied across the country and can be hard to follow at a macro-scale since individual financing or coordinated investment deals are handled on a site-by-site basis. Both Wake and Mecklenburg Counties derive much of their funding from the EPA. Each receives funds which are applied towards site assessments based on

either developer or city-initiatives. In addition to these assessment funds, Raleigh has a \$1 million revolving loan fund for clean-up of brownfield sites and Mecklenburg County offers matching cleanup funds with a maximum of \$20,000 per site. Mecklenburg County features the added requirement that sites be located within the bounds of a designated business corridor revitalization area. The zone circumferences about 75% of the urban and inner suburban areas around downtown Charlotte and 50 of 72 brownfield redevelopments are located within its bounds and nine (9) of 13 industrial redevelopments are within it (table 38). As seen in a comparison of their statistics, the revitalization area is where the redevelopments in declined areas have occurred. The areas not in the revitalization area are primarily located in suburban areas and take on the corresponding traits of being higher acreage sites in areas with higher rates of home ownership and income as well as less residential movement. The East Park area and Westinghouse Boulevard sites are not located within the revitalization area.

| Business Corridor Revitalization Area | Acreage | Mobility** | SF, %Owner-Occupied*** | Home Value** | Household Income*** |
|--|----------------|-------------------|-------------------------------|---------------------|----------------------------|
| Yes | 8.41 | 0.80 | -1.57 | -0.12 | -0.63 |
| No | 14.59 | 0.37 | -0.37 | 0.32 | -0.04 |
| All | 10.30 | 0.67 | -1.20 | 0.01 | -0.45 |

Table 38: Characteristics of brownfield redevelopments in Mecklenburg County, NC by location in relation to the business corridor revitalization area.

*** Significant at the .01 level

** Significant at the .05 level

Without a countywide inventory of brownfield sites it is impossible to accurately evaluate the true effectiveness of this revitalization area strategy. The area encompasses the tracts with the greatest number of inactive hazardous waste sites and delinquent tax sites. Additionally, corridors in the area such as Freedom Drive, Brookshire Freeway, and Graham

Street feature an abundance of obvious, undocumented brownfield sites. When compared to Westinghouse Boulevard and the East Park area, where only a handful of brownfield sites were seen, observational data suggests that perhaps a greater number of brownfield redevelopments occur within the revitalization area as a result of more brownfields being there as well as fewer greenfield sites. Additionally, the difference between sites in the revitalization area as compared to other sites is debatable in terms of cause and effect as revitalization areas are typically designed to target blighted or near-blighted areas. A comparison between the industrial and non-industrial sites in the area shows that the overall trends remain the same. Non-industrial redevelopments occur in areas of greater mobility and where there is a mismatch between income and property values. Industrial sites are considerably larger sites and occur in blighted areas with low mobility.

| Business Corridor Revitalization Area | Acreage | Mobility** | SF, %Owner-Occupied | Home Value** | Household Income*** |
|--|----------------|-------------------|----------------------------|---------------------|----------------------------|
| Industrial | 13.76 | 0.34 | -1.35 | -0.54 | -0.90 |
| Non-Industrial | 7.23 | 0.90 | -1.62 | -0.03 | -0.58 |

Table 39: Brownfield characteristics in the business corridor revitalization area of Mecklenburg County, NC by use.

*** Significant at the .01 level

** Significant at the .05 level

The prescriptive financing mechanism of a designated area signifying which sites qualify for a brownfield redevelopment grant is a simple way to target financing efforts at areas in need. However, observations show that it does not lead to redevelopment where other market forces are not at work. If it did, then Freedom Drive and Brookshire Freeway would not be corridors where redevelopment was so minimal and the existence of brownfield sites so evident upon visiting. Thus there is utility in considering whether there is not a more effective method of

utilizing public dollars and federal programs to fund brownfield redevelopment exists. The variables used in this analysis could be utilized as indicators to identify areas from around the county where certain funding methods are likely to be optimal compared to other options. Then municipalities could overlay potential brownfield sites on a map identifying such areas and identify where the largest clusters exist. Doing so would assist in targeting staff and public funding efforts toward neighborhoods with the greatest potential return on investment or greatest public benefit potential depending on the goals.

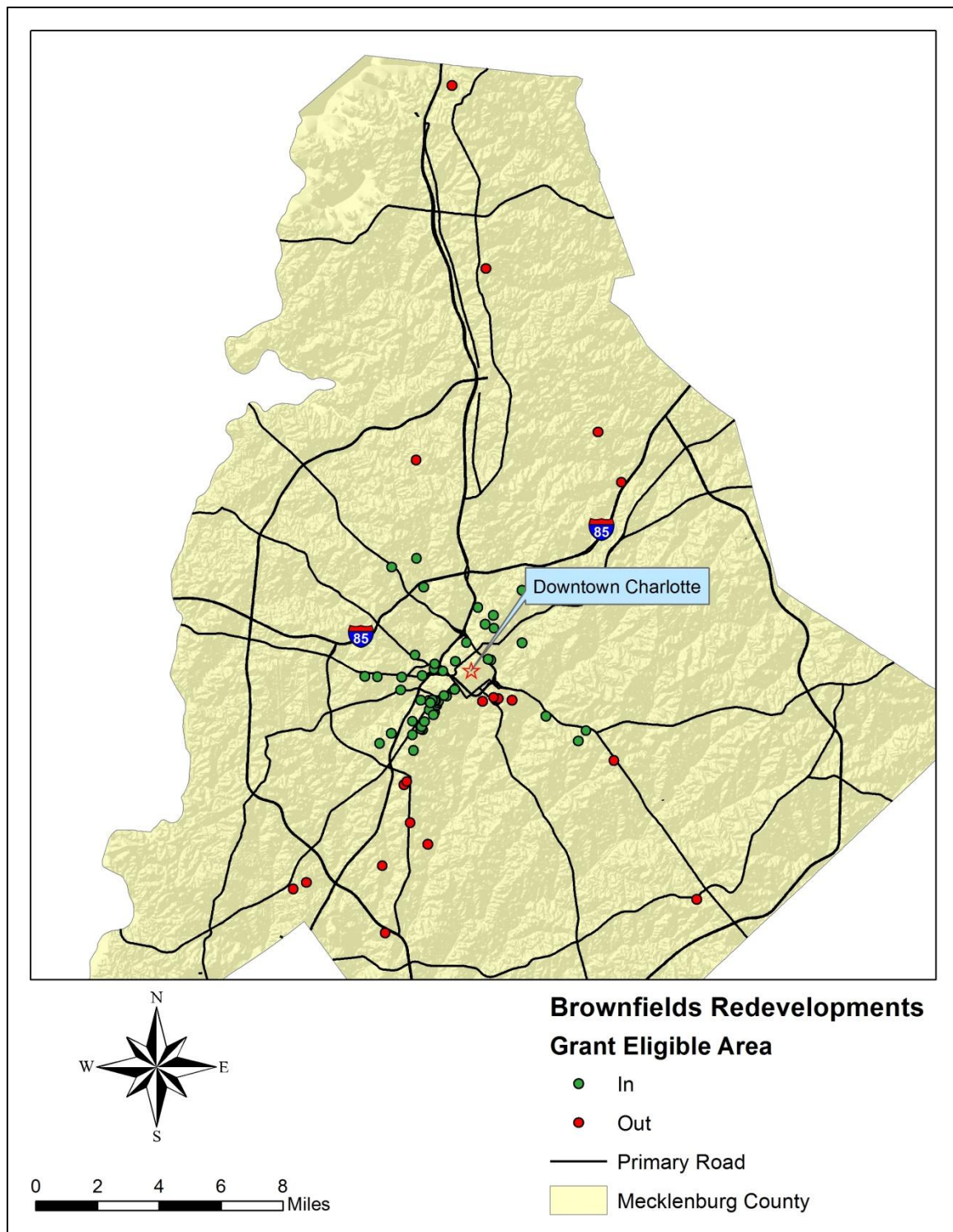


Figure 27: Map of brownfield redevelopments in relation to the business corridor revitalization area.
Source: Charlotte-Mecklenburg Neighborhood & Business Services

6.3.1: Appropriate Funding Mechanisms

There exist many funding options for redevelopment but for the purposes of this paper we will utilize some primary tools that were previously discussed in the literature review or are common to the planning profession: tax incremental financing (TIF), low income housing tax credit (LIHTC), historic preservation tax credits, community development block grants, and large public projects (primarily transportation). These will first be discussed in relation to the sites used in the analysis followed by a discussion of the variables and the associated theory.

Areas such as Camden Square and from downtown to Hutchinson Shopping Center would be optimal locations for tax incremental financing. First, the areas are made up of dilapidated properties adjacent to areas of economic growth. They are likely to increase in value naturally from development pressure but the growth would be accelerated through funding assistance toward cleanup, assessments, and area improvements. The evidence of likely latent demand in the area means that if properties begin to redevelop the assessed property values which will begin to rise. This minimizes risk of the TIF failing and optimizes returns in the way of increased property tax revenue and sales tax from commercial activity. Additionally, these sites benefit from large public projects, such as the recent and future light rail development, that can add to the momentum of development trends.

Summit Avenue and East Park differ from Camden Square in that they are areas where the neighborhood character is not likely to change with redevelopment. Residents do not move as often and are more prone to neighborhood attachment. While the neighborhoods themselves are in an economically viable state to support redevelopment and have good access to major commercial areas, such as downtown and the stadium area, they are not surrounded

by areas seeing significant growth. Summit Avenue is even adjacent to a severely blighted area. These areas would benefit from moves to allow increased density and/or investments in streetscape improvements. The areas are very different but the key points for both were they featured attractive streets and quality access. The increased density could be a way to create an incentive to recycle land. This can be done through reduced setback requirements or changes in the floor area ratio standards. The streetscape investments assist in making the area attractive for development and as a destination for visitors or consumers.

Depending on the character of the neighborhoods these are also the sites where the potential for historic preservation tax credits should be explored. Pilot Mills in Wake County shares tapestry segmentation with both Summit Avenue and East Park, indicating minimal area change. The redevelopment utilized historic preservation tax credits to restore and renovate an old mill into offices. Historic preservation tax credits are a way of retaining neighborhood character and increasing funds available to projects.

Large industrial areas, such as Westinghouse Boulevard, are the type of area where a standard brownfield redevelopment grant is likely the most efficient way to fund projects. The areas are not blighted which reduces the number of programs they qualify for, but they also do not face many of the added barriers that inner-suburban sites do. Summit Avenue and East Park are the other type of areas where grants may be effective. Essentially, all three are area types are where change is not likely and not necessarily needed, thus the easiest way to encourage redevelopment is to provide financial assistance toward site assessment or cleanup.

Finally, areas where redevelopment does not happen is the most complicated since public funding and other efforts are essentially fighting the market rather than working with the market. Freedom Drive especially, but also South Tryon Street near Camden Square and

Brookshire Freeway, are areas where there is little to build on to encourage redevelopment. The areas have many brownfields, additional greyfields, and the retail market is dominated by pawn shops, liquor stores, as well as alternative financial institutions with some industrial employment as well as basic office employment. Funding redevelopment in these areas is a research project of its own. Ideas from this analysis include LIHTC funds and infrastructure investments. LIHTC funds may be advantageous in that the areas are almost assuredly going to be qualified census tracts, meaning the funds may be higher than in other areas. City matches of projects using LIHTC could boost potential redevelopments as well as target limited funds and raise the project funds available.

Infrastructure investments in the three (3) aforementioned areas are a needed prerequisite for substantial redevelopment to become feasible. For basic infrastructure, cities may target these areas through community development block grant applications or prioritize them in the capital improvements program. Partnerships with telecommunication or electric companies may be considered for more advanced infrastructure improvements. The latter is just as important as the former given that a key difference between solo act market segments and metropolis segments is use of the internet. Attracting young professionals or the wealthier metropolis segment requires the availability of quality, dependable internet access for personal and professional use.

Taking these sites and the discussion as to what types of funding they may benefit from we can use the analysis and the variables to look at indicators as to what funding mechanisms should be considered for an area that is held down by brownfields or potential brownfield sites. Some theoretical consideration is given, as not every variable should be an indicator. The values in table 40 are drawn from the area characteristics of the sites discussed as found in the

statistical analysis. These indicators coupled with a redevelopment inventory or estimated inventory could identify areas and funding mechanisms to maximize sites redeveloped or to obtain maximum return on investment. An inventory of redevelopment sites is a necessary counterpart to these indicators. As, for example, with potential TIF districts, the home value is equal to the area median denoting average property values. But if within these areas a significant number of brownfield exist, then encouraging their redevelopment will increase cumulative area property values thus increasing property tax revenues. These indicators provide a way to merge the TIF redevelopment tool with brownfield redevelopment strategies at the community level.

| Type of Funding | Median Home Value | Median HH Income | Resident Mobility | Detached-Single-Family Owner-Occupancy |
|-----------------------------|--------------------------|-------------------------|--------------------------|---|
| TIF | Average / Low | Low | High | Low |
| Large Public Project | Average | Low | High | Low |
| Streetscape | Average | Average / Low | Low | N / A |
| Brownfield Grant | High / Average | Average | Low | N / A |
| LIHTC | Low | Low | Low | Low |
| Infrastructure | Low | Low | N / A | Low |

Table 40: Indicators as to funding type which should be considered.

Detached-single-family owner-occupancy rates are considered not applicable for streetscape or brownfield grants as East Park and Summit Avenue show that this variable is not a decisive factor in whether brownfield redevelopment occurs. Similarly, mobility is not a strong factor for infrastructure. This variable is what separates the speculative site of Hutchinson Shopping Center and the blighted area of Freedom Drive. But infrastructure investment is

needed in both areas, and a proposed investment in transportation is another key factor separating the two areas.

6.3.2: Comprehensive Planning and Zoning

Local governments assist in funding redevelopment but they also engage in comprehensive planning and zoning which is equally important to the brownfield redevelopment process as it determines what reuse options there are for developers and communities looking to remediate neighborhood brownfields. Plans for blighted area should leave open the option for light-industrial and commercial uses that are not customer oriented. Additionally, since these areas tend to be lower income they may produce less commercial demand and thus require less retail space. Particularly in a situation such as in Mecklenburg County where most of the low income and low property value areas are located along I-85 it is beneficial to permit uses that don't require significant customer exposure and are able to succeed in more blighted areas. Areas such as Freedom Drive may also benefit from converting brownfields, when possible, to open space in order to clear it. This opens the door to interim, formal or informal, uses by the community as well as lower demolition costs for potential developers. A breakdown of the types of uses that are likely to be supported based on theory and research in the short-to-mid-term based on area characteristics is seen in table 41.

| | No Decline | Low Income and Average Property Values | Low Income and Low Property Values |
|----------------------|----------------------|---|--|
| High Mobility | Highest and Best Use | New high-density residential/retail or commercial development | Make area investments to encourage speculation and redevelopment |
| Low Mobility | Highest and Best Use | Redevelopment/renovation for use based on neighborhood market | Light Industrial, Office Buildings, "Highway Commercial" |

Table 41: Use recommendations by the relationship of neighborhood mobility and income to property value relationship.

Areas susceptible or open to change are evidenced by resident mobility and low detached-single-family owner-occupancy rates but with rising property values and lower household incomes may do well by pursuing new residential and commercial-retail development in order to attract a broader consumer base, additional local businesses, and economic growth. Areas with these same economic traits, but low mobility and/or high rates of detached-single-family owner occupancy rates, are less likely to change in terms of residents and thus less likely to develop a new consumer base or denser development. These areas, such as Summit Avenue in Mecklenburg County or the Costco in Wake County, are more likely to redevelop for uses typical of the area. They may even use the same structure for different uses such as with Club 935 on Summit Avenue. Areas where both income and property values are average or higher are suggested to pursue the highest and best use as they should, in theory, be marketable sites other than the contamination risks. While redevelopment in these sites may still be affected by holdouts or economic downturns, these are not barriers that pursuing particular uses are likely to resolve but will be resolved if land demand increases.

In blighted areas, redevelopment may require adjusting community expectations from high-value redevelopment to practical redevelopment. In these areas where there is a level of

resident mobility and higher rates of renter occupancy, community investments may be best directed towards amenities to help inspire speculative value in the area. This is similar to what Mecklenburg County is pushing along Graham Street by proposing light rail and commuter rail extensions as well as making city purchases in the area such as the Hutchinson Shopping Center. These may also be the areas to benefit most from park development or conversion of brownfield and greyfield sites into long term public open space uses. Blighted areas that lack physical mobility amongst residents face the additional challenge of possible community resistance to change or relocation expenses being an additional cost to redevelopment. In addition to this, these areas likely have higher rates of unemployment or are in need of employment growth. Mecklenburg County shows these areas see some redevelopments in terms of light industrial uses as well as commercial uses such as offices and vehicle storage.

6.4: Additional Research

Additional research could, in addition to testing the findings of this analysis, assist in identifying specific strategies for the different areas where brownfields exist and redevelop. In the case of this analysis, further research could be done in regards to the financing of the project sites. This could include surveys into the number of times individual property or proprietor companies are sold, identification of trends in the proportion of public vs. private funds, or the development of a timeline that compares the announcement and construction of public projects, such as light rail stations or street improvements, to the date that developers agree to redevelop area brownfield sites. A timeline approach in key areas could reveal whether public improvements are correlated to brownfield redevelopments or vice versa. NCDENR keeps a record of initial inquiries into these sites thus it would be possible to identify the points of

initial interest in comparison to public announcements or public project start dates. Additionally, understanding the number of company or property sales involved with individual sites could provide an indication as to whether brownfield redevelopments are more or less stable. This could complement an understanding of the public-to-private funding ratio and have implications for funding tools that are best suited for these sites and their surrounding areas.

Additional research potential also exists strongly around the owner-occupancy rates of single-family housing units. Mecklenburg County and Wake County did not prove to be optimal study areas for parcel-level analysis with this variable as many of the sites were separated from single-family units. However, a parcel-level look at the sites on Summit Avenue suggests that single-family owner-occupancy at the tract was low but rose in proximity to the site. While the neighborhood appeared to be lower-middle class, it was fairly well maintained when compared with Freedom Drive. A survey of brownfield redevelopments adjacent to detached-single-family neighborhoods has the potential to produce needed insight about the prisoner's dilemma.

6.5: Conclusion

The preceding analysis was done primarily utilizing Mecklenburg County, North Carolina but was supported from a statistical standpoint as well as through limited observation of Wake County, North Carolina. While the individuality of communities is critical, the analysis and the implications of the results have merit for other communities. In two unique areas the variables were predictive of redevelopments and indicative of the likely end use of the redevelopments or whether the projects were a neighborhood altering redevelopment or closer to adaptive reuse that maintained the pre-existing character. The variables that were used are from the census and thus available to communities across America. This analysis shows how they could be used

at a county or city level to assist in crafting a redevelopment plan. Categorizing areas by the attachment or transience of residents, whether the single-family market is renter or owner-occupied, as well as income and property values, provide an estimation as to the character of the neighborhood in a way that is an indication of how brownfields needing to be redeveloped can be efficaciously handled. This is pertinent to identifying what areas may need what level of funding or types of investment.

Redevelopments share traits based on their positioning relative to the surrounding area. Higher property values and lower income means an area may be in transition toward new development. Areas of economic vitality will see some sites recycled but are dependent on economic vitality, location, and a level of physical quality in the public space. Brownfields may redevelop into industrial sites in low-density suburban areas but also the most blighted areas as this is where non-industrial development pressure is lower. Understanding how these redevelopments fit with the surrounding area means communities can identify what types of redevelopment are likely to occur with minimal assistance and what uses may require substantial neighborhood changes or investment.

Funds and funding options will vary by county. As will the extent of brownfields and the percentage of a city or county that shares characteristics with the areas found in this analysis. However, any city or county will almost assuredly have some of each type of area. Breaking them down will help to target funding and community efforts better than a generic program alone that puts a majority of the brownfields on the same level. In the instance of Charlotte, \$20,000 is not going to lead to redevelopment along Freedom Drive; similarly, in the case of East Park it is likely a general slowdown in commercial development in the area is more at fault than a developer's pro-forma being short \$20,000 on the vacant properties. Recognizing this means

redevelopment plans may incorporate unique community strategies to encourage redevelopment and augment grants through appropriate coordinated investments.

Understanding how brownfields fit into the urban fabric has short, mid, and long term implications for all cities. In the short term, fiscal conservancy is becoming a topic of increasing relevance and public funds are becoming limited. Developing targeted strategies for maximum benefit is critical. In the midterm, neighborhoods with a few small brownfields may see their property values held down and commercial activity limited. By utilizing targeted strategies or understanding appropriate investment tools, communities and cities can help encourage recycling land thus preventing neighborhoods from reaching a tipping point and falling into a blighted state unnecessarily. In the long term there are currently approximately 600,000 brownfield sites in the United States and the business cycle will continue to produce more. Knowing the magnitude of the problem it is clear cities must have ongoing strategies that can continually address brownfield sites. This analysis has provided insight into how cities could address these issues through dynamic and targeted strategies utilizing basic neighborhood indicators. Incorporating these indicators as well as inventories or estimated inventories of brownfield properties into capital improvements programs or comprehensive plans can help cities address brownfield redevelopments in a coordinated fashion.

APPENDIX

| Segment Group | Description |
|--------------------------------|--|
| High Society | Affluent, well-educated, married-couple homeowners |
| Upscale Ave. | Prosperous, married-couple homeowners in different housing |
| Metropolis | City dwellers in older homes reflecting the diversity of urban culture |
| Solo Acts | Urban young singles on the move |
| Senior Styles | Senior lifestyles by income, age, and housing type |
| Scholars & Patriots | College, military environments |
| High Hopes | Young households striving for the "American Dream" |
| Global Roots | Ethnic and culturally diverse families |
| Family Portrait | Youth, family life, and children |
| Traditional Living | Middle-aged, middle income - Middle America |
| Factories & Farms | Hardworking families in small communities, settled near jobs |
| American Quilt | Households in Small Towns and rural areas |

Table 42: Overview of all 12 ESRI Tapestry segment groups.

References

Ahlbrandt, R. & Brophy, P. (1975). *Neighborhood Revitalization*. Lexington, Massachusetts: D.C. Heath and Company.

Amekudzi, A. & Fomunung, I. (2004). Integrating Brownfields Redevelopment with Transportation Planning. *Journal of Urban Planning and Development*, 130 (4): 204-212.

American Planning Association. (2011). *Reuse: Creating community-based brownfield redevelopment strategies*. Retrieved October 9, 2011 from:
<http://www.planning.org/research/brownfields/pdf/brownfieldsguide.pdf>

Atlantic Station. (n.d.). In *Wikipedia*. Retrieved December 3, 2011, from:
http://en.wikipedia.org/wiki/Atlantic_Station.

Bacot, H. & O'Dell, C. (2006). Establishing Indicators to Evaluate Brownfield Redevelopment. *Economic Development Quarterly*, 20 (2): 142-161.

Bartsch, C., Ward, M., Brown, K., Dickson, D., Thorsen, B., Ewen, A., & Fox, P. (2004). *Unlocking brownfields: Keys to community revitalization*. Washington, DC: National Association of Local Government Environmental Professionals.

BenDor, T., Metcalf, S. & Paich, M. (2011). The Dynamics of Brownfield Redevelopment. *Sustainability*, 3 (6): 914-936.

Blair, J. (1991). Land Use. *Urban & Regional Economics* (344-393). Homewood, IL: Irwin.

Cervero, R. & Duncan, M. (2002). Transit's Value-Added Effects: Light and Commuter Rail Services and Commercial Land Values. *Transportation Research Record: Journal of the Transportation Research Board*, 1805: 8-15.

Chrysochoou, M., Garrick, N., Segerson, K., Bagtzoglou, A., Dahal, G., Brown, K. & Granda-Carvajal, C. (2011). *Reversing Urban Sprawl: A Reclaimability Index Approach for Reviving Downtown Brownfields*. Storrs, CT: Center for Transportation and Livable Systems, University of Connecticut.

Davis, O. & Winston, A. (1961). The Economics of Urban Renewal. *Law and Contemporary Problems*, 26 (1): 105-117.

De Sousa, C. (2005). Policy Performance and Brownfield Redevelopment in Milwaukee, Wisconsin. *The Professional Geographer*, 57 (2): 312-327.

De Sousa, C., Wu, C., & Westphal, L. (2009). Assessing the Effect of Publicly Assisted Brownfield Redevelopment on Surrounding Property Values. *Economic Development Quarterly*, 23 (2): 95-110.

Environmental Protection Agency. (2011). *Brownfields and Land Revitalization*. Retrieved October 20, 2011 from: <http://epa.gov/brownfields>.

Farris, J. (2001). The Barriers to Using Urban Infill Development to Achieve Smart Growth. *Housing Policy Debate*, 12 (1): 1-30.

Fersko, J. and Schrieber, R. (1998). *Finding Gold in Brownfields: Overcoming Liability, Cost and Time Hurdles*. DEVELOPMENT Magazine, Spring 1998: p. 12, 14, 16.

Green Leigh, N. (2000). *Promoting More Equitable Brownfield Redevelopment: Promising Approaches for Land Banks and Other Community Land Development Entities* (Lincoln Institute Product Code: WP00NL2). Cambridge, MA: Lincoln Institute of Land Policy. Retrieved October 2, 2011 from: http://www.lincolninst.edu/pubs/84_Promoting-More-Equitable-Brownfield-Redevelopment.

Guignet, D. and Alberini, A. (2010). Voluntary Cleanup Programs and Redevelopment Potential: Lessons from Baltimore, Maryland. *Cityscape*, 12 (3): 7-36.

Hartshorn, T. (1992). Central Place theory. In *Interpreting the City: An Urban Geography 2nd Ed.* (137-156). New York: John Wiley & Sons.

Haslam, C. (2009). Urban Redevelopment and Contaminated Land; Lessons from Florida's Redevelopment Program. *Environmental Practice*, 11 (3): 153-162.

Hess, D. & Almeida, T. (2007). Impact of Proximity to Light Rail Transit on Station-area Property Values in Buffalo, New York. *Urban Studies*, 44 (5): 1041-1068.

Hollander, J., Kirkwood, N., & Gold, J. (2010). *Principles of Brownfield Regeneration*. Washington, DC: Island Press.

Howland, M. (2010). The Private Market for Brownfield Properties. *Cityscape*, 12 (3): 37-54.

Hula, R. & Bromley-Trujillo, R. (2010). Cleaning Up the Mess: Redevelopment of Urban Brownfields. *Economic Development Quarterly*, 24 (3): 276-287.

Inactive Hazardous Sites Program. Retrieved February 13, 2012 from:
<http://portal.ncdenr.org/web/wm/sf/ihshome>.

International Economic Development Council. (2011). *Brownfields Redevelopment Manual*. Retrieved October 20, 2011, from:
http://www.iedonline.org/?p=Brownfields_Redevelopment_Manual.

Kaufman, D. & Cloutier, N. (2006). The Impact of Small Brownfields and Greenspaces on Residential Property Values. *Journal of Real Estate Finance Economics*, 33 (1): 19-30.

Knapp, G. & Ding, C., & Hopkins, L. (2001). Do Plans Matter? The Effects of Light Rail Plans on Land Values in Station Areas. *Journal of Planning Education and Research*, 21: 32-39.

Knox, P. (1994). *Urbanization: An Introduction to Urban Geography*. Prentice Hall.

Lang, R. & Knox, P. (2009). The New Metropolis: Rethinking Megalopolis. *Regional Studies*, 43(6): 789-802.

McCarthy, L. (2009). Off the Mark? : Efficiency in Targeting the Most Marketable Sites Rather Than Equity in Public Assistance for Brownfield Redevelopment. *Economic Development Quarterly*, 23 (3): 211-228.

Meyer, P. (2003). Brownfields and Red Ink: The Costs of Contaminated (and Idle) Land. *Environmental Practice*, 5 (1): 40-47.

Meyer, P. & Yount, K. (2003). Financing Redevelopment of Brownfields. In S. White, R. Bingham, and E. Hill (Ed.), *Financing Economic Development in the 21st Century* (233-249). New York: M.E. Sharpe Inc.

North Carolina Department of Environment and Natural Resources. (2011). *Annual Report to the North Carolina General Assembly: The N.C. Brownfields Program*. Retrieved January 27, 2012 from: http://portal.ncdenr.org/c/document_library/get_file?uuid=b4d044a6-aa16-44cc-8418-37b8c4749bcb&groupId=38361.

Portland Harbor Redevelopment Initiative. Retrieved October 20, 2011 from: <http://www.pdc.us/ura/willamette-industrial/harborredi.asp>.

Schwirian, K. (1983). Models of Neighborhood Change. *Annual Reviews Social*, 9: 83-102.

Simons, R. & Iannone, D. (June 1997). Brownfields: Supply and Demand. *Urban Land*. Retrieved from: <http://www.rasimons.com/documents/articles/brownfields-supply-demand.pdf>.

Stromberg, M. (2009). A Use for Michigan Brownfields. *Planning*, March, 9.

Swickard, T. (2008). Regulatory Incentives to Promote Private Sector Brownfield Remediation and Reuse. *Soil and Sediment Contamination*, 17 (2): 121-136.

Temkin, K. & Rohe, W. (1996). Neighborhood Change and Urban Policy. *Journal of Planning Education and Research*, 15 (3): 159-170.

Thomas, M. (2002a). A GIS-based decision support system for brownfield redevelopment. *Landscape and Urban Planning*, 58 (1): 7-23.

Thomas, M. (2002b). A Weighted, Multi-Attribute, Site Prioritization and Selection Process for Brownfield Redevelopment. *Environmental Practice*, 4 (2): 95-106.

U.S. Conference of Mayors. (2010). *Recycling America's Land: A National Report on Brownfields Redevelopment* (Volume IX). Washington, DC: Retrieved from <http://www.usmayors.org/pressreleases/uploads/November2010BFreport.pdf>.

Walzer, N., Hamm, G. & Sutton, L. (2006). Involving Brownfields in Community Development: Preliminary Findings. *Journal of the Community Development Society*, 37 (1): 79-89.